

RADIUM AND CANCER

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(CURIETHERAPY)

BY

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WITH EIGHT PLATES (FOUR COLOURED) AND
SIXTY-FOUR ILLUSTRATIONS IN THE TEXT



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INTRODUCTION

IN writing this small book of my personal experiences and observations in the field of curietherapy I am fully aware of the very elemental knowledge that most of us possess upon the subject.

I feel confident that many of the methods we adhere to and preach to-day will not be in use in ten years' time. I hope that progress will be so rapid that this may be said of most of our present-day methods. Rules therefore are laid down merely as guides and are not to be regarded in any way as final. One realises that they are laid down by others who are like ourselves groping in the dark.

The person who has unlimited radium will employ it in an entirely different and more lavish manner from the person whose supply is limited.

Many institutions are acquiring small amounts—say 50 to 100 milligrammes of radium. If one person uses this it is enough for a limited number of patients. If many surgeons have the right to use it and the time allowed to each surgeon is curtailed it becomes worse than useless.

I speak from experience for at St. Mary's Hospital we had for some years 155 milligrammes—one-third of which was in needle form. Every surgeon and physician had equal right to it though I think that the needles used were in my wards more than 75 per cent. of the time. My results I can frankly state in operable cases were no better than those of surgery. In some cases perhaps they were worse. The inoperable cases of course obtained a measure of relief unobtainable by any other method. My poor results continued until I realised that more radium was needed to do useful work and

then supplemented the hospital supply from my private source which has varied from time to time but which never exceeded 250 milligrams

This amount however together with the hospital supply has completely revolutionised my results as well as enabling me to pursue methods of treatment which were impossible previously. For instance it was impossible for me to monopolise the whole radium supply of the hospital by applying a cuirasse to one patient for fourteen to twenty-one days so that no surface radiation could be carried out in St Mary's Hospital. Another great difficulty is the number of hopeless cases which are sent for treatment to anyone who is known to be interested in a new method. The problem arises is one to concentrate and attempt to cure a few or to do one's best to alleviate the many? Scientific investigation is thus interfered with by the claims of humanity.

This book can only claim to be a guide to those whose supply of radium is as limited as my own and who therefore must perforce adopt a similar method of procedure.

I speak only of what I have seen and certain diseases which should be included in any exhaustive book such as those of the central nervous system have been omitted.

Among the cases quoted will be found a large proportion of those which cannot be counted as successes but successes are what we expect and when met with teach us very little. Want of success on the other hand presents a problem to be pondered over and solved so that I feel I learn more from failure than I do from success. If the failures published here prevent the repetitions of my mistakes by others they amply justify their publication.

I have to thank Mr George Cathcart for looking over many of the notes and for his valuable suggestions and my colleagues at St Mary's Hospital for their kindness in allowing me to use certain cases. I make grateful acknowledgment to Professor Regaud Drs Roux Berger Monod Laborde and their colleagues at the Curie Institute at Paris for their teaching help and inspiration.

Mr Keynes and Mr Cade have kindly allowed me to use illustrations of their method of dealing with breast cases

Mr Malcolm Donaldson who has done so much for radium investigation in this country and who really introduced most of us to the proper use of radium has kindly written the chapter on carcinoma of the uterus for which I am most particularly grateful

Lastly I must express thanks to Mr Geoffrey Pearce and Miss Robertson of the Chemical Service Co Ltd for their kindness in lending me blocks of instruments and for the many suggestions which have been incorporated in this book.

D C L F

57 GROSVENOR STREET W 1

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CHAPTER I

HISTORY

HENRI BECQUEREL noted in 1896 that uranium salts were luminous and affected a photographic plate though wrapped in dark paper or even in thin sheets of metal. He advanced however little towards the precise cause of this. Marie Sklodowska a Pole took up the study and afterwards married a scientist of equal ability Dr Pierre Curie who was also interested in the subject. In 1898 radium was discovered. The metal was only isolated some years later by Mme Curie aided by M. Debierne.

The twenty fifth anniversary of the discovery of radium was made the occasion of a celebration in the amphitheatre of the Sorbonne on the 26th December 1923 under the Presidency of M. Alexandre Millerand the President of the Republic at which were represented most of the learned societies of the world.

Pierre Curie died in 1906 but Mme. Curie now presides over the Fondation Curie which is the home of radium for the whole world and where the study of its properties both physical and medical has proceeded ever since its foundation at that time.

The production and cost of radium ¹

Radium is produced chiefly from four ores

(1) Pitchblende which is an impure oxide of uranium containing beside this metal lead silica iron and selenium. It is found in large quantities in the Belgian Congo and is by

¹ I am indebted to Prof W. E. Dixon, M.A. M.D. F.R.S. of Cambridge for much of the information contained under this heading.

far the most important ore from which the element is obtained

Pitchblende also is found in Cornwall and the British Radium Company have extracted some 10 grams from this source. It is difficult however to see how white labour can ever compete with cheap black labour of the Congo Pitchblende is also found in Austria Portugal and America.

(2) Carnotite is a potassium uranyl canadate and is found in Colorado and Utah



FIG 1 —RADIUM (3.4 GRMS) PHOTOGRAPHED BY RADIATION EMITTED
PREPARED BY THE UNION MINIERE DU HAUT KATANGA.

(3) Autunite or uranite is a calcium uranium phosphate which contains lead and is chiefly found in Portugal and Australia

(4) Betaphite is found with mesthorium in Madagascar

Radium was produced commercially first as a monopoly from the pitchblende of Joachimstal in Austria and to a less extent from the uranite of Portugal. The price of the element fluctuated greatly at this time. In 1905 it was priced at between £5 to £10 per mgm. in 1909-1910 at £15

to £27 in 1912 1914 at £36 per mgm. At this date the mines of America began to compete and as the result of this the price fell in 1915 to £35 per mgm and in 1916-1922 from £24 to £21. Then the Belgian Congo came into the market and in 1923 the price dropped still further to £14 and now stands at £12 being a little higher now than two to three years ago.

When the Radium Committee of the Mount Vernon Cancer Hospital at Northwood went into the question of acquiring radium in large quantities negotiations were opened up with our own mines in Cornwall and also with the Czecho-Slovakian Government for radium said to be in their possession which we heard was offered at a lower price than the Belgian radium and that immediate delivery might be obtained, as against a long wait for the Belgian supply. Negotiations with neither of these sources proved successful and we ordered our radium from Belgium in the end. Our delay was greatly shortened by having the needles filled and all the technical work performed in this country.

It is unlikely that the price of radium will diminish greatly for a large amount of ore must be crushed to obtain a small amount of the element. The element may be lost but it cannot be used up and therefore this must affect the demand. The sudden and urgent cry for radium has only been made since the International Congress on Cancer held in London in 1928. It is unlikely that any financial group would put up much money to produce an article without a very substantial profit when it is remembered that the demand and the use for the article would vanish at once with the discovery of some other and better way of treating cancer. This rather confirms the view expressed above about the predominant position of the black labour of the Congo. At the present time the Union Minière du Haut Katanga produces 95 per cent of the radium of the world.

CHARACTER OF RADIUM

It is unnecessary to describe the preparation of radium from its ores as this would only interest the engineer and the chemist

Radium is a rare radio-active element (symbol Ra) with an atomic weight of 226 belonging to the alkali group of metals which include barium strontium calcium and magnesium. Radium is never found apart from its parent element uranium they occur in the ratio of one part of radium to 3,400 000 parts of uranium and as uranium is not a common metal the relative quantity of radium in a ton of ore is very minute

In its metallic form it is a pure white metal but on exposure to air quickly reacts with water to form radium hydroxide. Hence only its salts are used for therapeutic purposes.

There are a number of radio-active substances uranium polonium actinium thorium and mesothorium but radium is by far the most valuable and important as it disintegrates at the required rate

In 1902 Rutherford and Soddy enunciated their well known atomic disintegration theory which is too complicated to be explained here though most important to the scientist who wishes to understand the behaviour of radium

Radio-activity is the spontaneous emission from the nucleus of a complex atom of helium nuclei called Alpha rays or of single negative electrons or Beta rays at high speeds with the production of new forms of matter. It is the outward evidence of the spontaneous disintegration of the radio-active substance or transmutation of the element atom by atom into other substances

This disintegration proceeds at a definite rate. One per cent of radium disintegrates in twenty five years so that the radio-activity of a pure radium preparation will continue uninterruptedly for a period of 2500 years one half of its atoms disintegrating in 1690 years. Lead with an atomic

weight of 206 is the end product but there are at least seven intermediate bodies known through each of which the transmutation must pass

Substance		Half Life Period	Radiation
Active Deposits	Uranium	5 billion years	α
	Radium	1690 years	α β γ
	Emanation (Radon)	3 85 days	α
	Radium A	3 minutes	α
	Radium B	26 8 minutes	β
	Radium C	19 5 minutes	α β γ
	Radium D	16 5 years	β (?)
	Radium E	5 days	β γ
	Radium F (Polonium)	136 days	α
	Radium G (Lead A W ⁿ 206)	—	—

Each of these substances is formed from the preceding one after the manner of a cascade accompanied by an outburst of energy evidenced by the emission of rays so that we see that the transmutation of metals which was the dream of the alchemist of the middle ages has at last become fact

The rays of radium

The work of Giesel Becquerel and Villard separated three distinct sorts of rays

The Alpha Rays (α) These are positively charged particles of helium shot out from the nuclei of the parent at approximately 12 000 to 18 000 miles per second They are completely absorbed by three inches of ordinary air and possess no therapeutic value

The Beta Rays (β) are negative electrons shot out from the parent atom at a velocity varying from 60 000 to 180 000 miles per second. Hard Beta rays are absorbed by one millimetre of lead or 4 millimetres of aluminium they are 100 times more penetrating than the α rays

The Gamma Rays (γ) These are unlike the α and β rays which are minute material particles or corpuscles while the γ -rays are high frequency vibrations similar to those of light. They travel at 186 000 miles per second. They will penetrate 6 to 8 inches of soft tissues and take $5\frac{1}{2}$ inches of lead to absorb them. They are 100 times more penetrating than the β -rays. It is these rays which we depend upon for therapeutic action.

Secondary radiation

According to their power of penetration there are soft and hard β and γ rays. Each of the three sorts of rays when passing through or impinging upon material bodies sets up secondary radiation. Thus α rays can produce feeble secondary β rays sometimes termed δ radiation. β rays produce secondary γ radiation and the γ rays secondary β radiation.

The intensity of radium rays and therefore their effect on tissues varies according to Newton's law inversely as the square of the distance from the source of radiation.

Quantitative measurements

The unit of measurement for radium is the milligramme. The primary standard is a glass tube containing 21.89 milligrammes of pure radium chloride prepared by Madame Curie which was adopted by the International Radium Standards Committee in March 1912 and is deposited at the Bureau International des Poids et Mesures at Sèvres.

Emanation

Just as radium is the disintegration product of uranium so radium in its process of decay forms a series of substances the first of which is known as radium emanation or Radon. Radon is a gas possessing the property of radio-activity.

Radio-active equilibrium.

From the time of sealing radium salts emanation is constantly formed in proportion to the weight of radium

present half the emanation produced during each unit of time is disintegrated in 3.85 days. The weight of radium remaining practically the same and there being a definite ratio between the quantities of emanation destroyed and produced there comes a time when the decay and the production balance each other. This is reached in about 30 days after sealing and the radium is then said to be in equilibrium.

The process of making radon need not be gone into. A large amount of radium is needed and therefore radon can only be obtained from institutions possessing large amounts of radium.

Radon has a very short lived activity. Its decay proceeds at a definitely known rate. During the first twenty four hours it loses 16 per cent of its radio-activity in 3.85 days it loses 50 per cent and in 8.8 days 80 per cent. in thirty days nothing remains. Its decay is known to the hour but the above figures are all that are necessary.

Unit of measurement for radon.

The millicurie is the unit of measurement for radon. It is the thousandth part of a curie. A curie is the quantity in equilibrium with one gramme of radium element at 0°C and 760 millimetres of mercury pressure. One millicurie of emanation equals in gamma ray activity one milligramme of radium element.

The millicurie is subdivided into a microcurie which is its thousandth part and the microcurie again into the millimicrocurie the thousandth part of the microcurie.

Unit of dosage

Dosage is calculated in three ways

- (1) By milligramme hours.
- (2) By microcuries destroyed per hour
- (3) By millicurie hours

(1) A milligramme hour is the amount of radiation given off by one milligramme of radium element in one hour.

There are two factors one the radium and the other the

time If it is desired to give 1000 milligramme hours it can be given in many ways decreasing the one factor and increasing the other for instance

1000 milligrammes of radium for 1 hour = 1000 milligramme hours.

500	2	=
200	5	=
100	10	=
10	100	=

and so on each number multiplied by the other giving 1000 milligramme hours The effect however is not the same

In early days large doses for short periods were given but owing to the researches of Regaud and Ferroux the amount of radium has been diminished and the time factor increased It is found that while rabbits testicles can be sterilised by small doses spread over several periods without harm they cannot be sterilised by one large dose unless given for such a time that radium necrosis of the tissues occurs This has had a great influence on curietherapy during the last few years the amount of radium becoming smaller and the time factor longer

Milligramme hours is the way dosage is calculated throughout this book as I use radium element and not radon The amount of radium \times the hours of the day \times the number of days for example 50 milligrammes of radium \times 24 hours \times 7 days = $50 \times 24 \times 7 = 8400$ milligramme hours

(2) Microcuries destroyed per hour This method of calculation was used with the old surface applicators but is not much used nowadays One gramme of element in equilibrium destroys 7.51 millicuries of emanation per hour and thus one milligramme hour of element ≈ 7.51 microcuries

(3) When using microcuries as units of intensity multiples of five were used and the applicator was made to contain a quantity of radium computed to provide an intensity of for example

For 5 microcuries destroyed per hour 0.66 mgr radium element

10	1.30
25	3.33

The conversion of milligramme hours into microcuries destroyed is obtained by multiplying the number of milligramme hours by 7.51. $1000 \text{ milligramme hours} = 1000 \times 7.51 = 7510 \text{ microcuries destroyed}$. To convert microcuries into milligramme hours the number of microcuries must be divided by 7.51. $1000 \text{ microcuries destroyed} = \frac{1000}{7.51} = 133 \text{ milligramme hours}$. This is far more commonly used as a method of calculating dosage than the last. One millicurie being the quantity of emanation in equilibrium with 1 milligramme of element it is evident that a preparation containing 10 milligrammes of radium element applied for one hour will equal in intensity 10 millicurie hours and correspond to 10 milligramme hours.

When stating the quantity of microcuries or millicuries destroyed this term indicates the quantity of radon which is produced and destroyed during the hour while when stating the intensity in millicurie hours a constant quantity of emanation in equilibrium with radium is indicated.

The advantages and disadvantages of using element or radon

(1) The element is expensive but stable and always will be ready for use.

Radon is comparatively cheap but worthless after a week it must be applied at once. The time lost even in sending through the post diminishes its value 16 to 30 per cent.

(2) There is danger of loss of the element as its containers are so minute. Either a nurse or a nursing home is needed therefore to guard against loss. Its insurance is expensive.

Radon is valueless except for its platinum container and therefore can be used in the out patient department and in cancer depots where patients need not be warded.

(3) Once the element is purchased no further expense except insurance is incurred.

Radon requires a highly technical staff to manufacture it continuously an expensive apparatus to make it and above all some £12,000 worth of radium locked up which can be used for no other purpose.

(4) The modern technique calling for the longer and longer time factor in treatment has gradually diminished the uses of radon and now it is mostly used in what is supposed to be hired radium. In establishments which make an income by hiring it out to anyone who requires it the monetary inducement unfortunately inclines them to allow it to pass into the hands of those who are quite ignorant of radium technique. Commercial institutions are already being formed to exploit this business and it will not be long before it will be placed at the free disposition of the most ignorant and we shall see a wave of ignominy, disappointment and contempt poured upon curietherapy which such actions will fully deserve. Unfortunately scientific investigation and scientific use of radium may suffer with it.

HANDLING OF RADIUM

CONSTANT contact with radium will produce the same disastrous results as exposure to the λ rays such as inflammation of the nails, fingers and hands. Frequent exposures even of the shortest duration will in time produce this result. The strictest precautions should therefore be observed in handling radium, its emanations or radon or apparatus containing them.

The irritation is caused chiefly by the Beta rays and as these have a shorter range of penetration than the Gamma rays, protection is the more easily attained.

The handling of the needles for threading or manipulating should be done with the body protected by a lead screen of which there are several patterns. The screen cuts off all the rays from the head and body of the manipulator. Thick rubber gloves must also be worn or the needle may be held in forceps or thick drainage tube. Gloves can be procured with the fingers faced with lead and rubber such as are used in the λ ray department.

Nurses and attendants who are constantly exposed to the rays should have their occupation changed at least once every

three months. If this is not done a severe anaemia may result amenorrhoea is not uncommon and sterility will follow among those who work with radium probably as frequently as in those who work with the γ rays

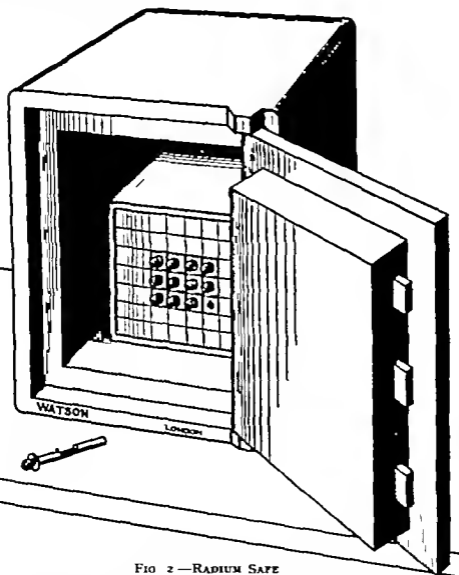


FIG 2—RADIUM SAFE

On account of its value radium should be kept in a safe of the ordinary type with a good lock. On account of its power of penetration special precautions must be taken. The safe should not be kept in a living room but should be placed in a situation remote from occupation.



FIG. 3.

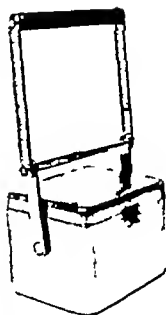


FIG. 5

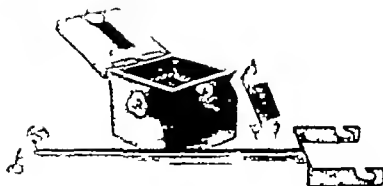


FIG. 4

FIGS. 3 AND 4.—RADIUM BOX SHUT AND OPEN
 FIGS. 5 AND 6.—ANOTHER PATTERN

The radium should be kept in narrow compartments which are really interruptions two inches long in the middle of solid cylinders of lead eight inches long leaving three inches of solid lead both in front and behind the compartment. The whole tube as it is called slides in and out of a block of lead one and a half inches square and eight inches long. If there are four of these cylinders in the safe they are arranged in such a manner that there are at least two eight inch blocks of lead one and a half inches square on each side of them so that there are three inches of lead protecting the radium on all sides. That is to say there will be thirty six solid blocks of lead the radium lying in small compartments in the



FIG 6

central four see Fig 2. As the weight of each block of lead is $7\frac{1}{2}$ lbs the weight irrespective of the iron safe is well over two hundredweight. The safe is usually made to stand at a convenient height on a strong cupboard which serves to keep the apparatus such as carrying boxes forceps and wire.

Radium is carried in small square lead lined boxes which have a long handle attached to them so that the hand is kept at a distance from the element.

When the needles and tubes are removed from the safe they should never be handled but should be put straight into the lead lined boxes in which they are to be conveyed to the patient. Long forceps are used for this purpose as the needle is hollow and the shell is thin no undue pressure

should be made upon it or it will be crushed the ends are the only solid parts

Needles are usually carried in small circular boxes which are bored out of solid lead having a quarter of an inch lead lining They are of different lengths to suit the different lengths of needles used. Care should be taken to see that

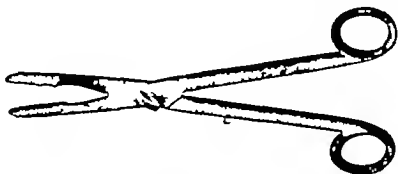


FIG 7—WOODEN FORCEPS FOR HANDLING RADIUM

there is sufficient lead in the lid and the bottom of the box makers often save on the lead in these situations These boxes can be carried in the pocket or sent through the post They are usually round but mine are made octagonal so that they will not roll when laid down The owner should have his name and address engraved on the outside of the box.

Wooden containers are also on the market but are much inferior to lead lined boxes

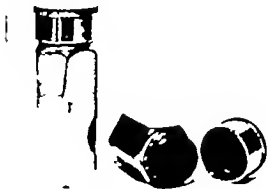


FIG 8—SMALL HEXAGONAL RADIUM BOXES. AUTHOR'S PATTERNS

CHAPTER II

CURIETHERAPY

Curietherapy

CURIETHERAPY means the treating of disease by means of radium and it is really divided into two classes general curie therapy and local or focal curietherapy

General curietherapy is the ideal at which scientists are aiming but which at the present moment no one has succeeded in attaining. It consists in introducing radio-active bodies into the blood so that they will act throughout the system. It alone can attack the whole neoplastic area primary growth glands and internal metastases. The difficulties in giving a lethal dose to the neoplasm before injury is inflicted on other tissues have so far barred the way to success. It is not however beyond the bounds of possibility that this will be done.

Local or focal curietherapy consists in enclosing the radio-active body in a focus call it seed needle tube container it matters not what and bringing this into a position so that it can act upon and kill the new growth.

This book deals only with local or focal curietherapy.

(1) The term internal curietherapy is applied when a focus of radium is placed internally in a natural cavity such as the cervix uteri or oesophagus.

(2) Interstitial curietherapy consists in the introduction of a focus of radium into the tissues as in the treatment of the breast or tongue by needles.

(3) External curietherapy consists in treating skin conditions by radium placed at a very short distance from it. From this has developed the system of telecurietherapy or treatment of malignant conditions by radium at a distance.

This was first used for superficial conditions but now is used for deep seated growths. This method needs to be mentioned only. Huge quantities of radium are used as much as 45 grammes enclosed in thick lead boxes or bombs. The shortage of radium in this country has prohibited its use and even where it has been tried extensively the results are not yet fully established. See p 33

METHODS OF USE

THE method of using radium in the treatment of malignant growths has scarcely emerged from the experimental stage and we are not certain yet whether we are using the right doses in the best way it may be that in ten years time we shall be using it in a different manner. At first it was applied directly to the skin over the growth by means of surface applicators but this has gone completely out of use except for certain skin affections and the radium is now placed in the malignant tissue if possible by means of seeds needles tubes and applicators

Seeds

This term is applied to a tiny capillary glass tube one millimetre in diameter and two to three millimetres long containing one or two millicuries (so called after Madame Curie) of radon. This capillary glass tube may or may not be screened by being enclosed in gold silver or platinum to cut off some of the Beta rays

The screen has a hole in the end to which a fine silk thread can be attached to recover the seed from the tissue when it has done its work. This seed is introduced into the tumour or tissues round about. It may be recovered after if attached to a silk thread or it may be left in and may gradually work out but no trouble need be taken to remove it

It is calculated that one millicurie gives out about 132 millicurie-hours of radio activity before it decays or dies. It dissipates its energy so rapidly at first that it is important

to insert the seed as soon as possible after it has been received from the institution that has made it. As the time of sealing the tube may not be known it is difficult to gauge the dose which has been given.

A special introducer is needed to insert the seed and many are upon the market. The simplest resembles an ordinary trocar and canula after inserting this into the required position the trocar is withdrawn and the seed placed in the canula and pushed into place by a special introducer. A more complicated one has a slot cut in the side through which the seed is introduced a spring holding it in position. Most of these instruments require three hands one to hold the instrument steady one to raise the spring and one to insert the seed. I have one with a magazine to contain one to four seeds which can be charged beforehand. The instrument is fitted with an outer tube which I can fix by a screw in any position thereby ensuring that I plant all the seeds at the same distance from the surface. I can set it again for the next series. In this way I can distribute a uniformity of dosage to the entire growth.

AN IMPROVED RADON SEED INTRODUCER

The following radon seed introducer was shown at the International Cancer Conference held here in 1928. See Fig. 9.

The barrel of this instrument consists of two tubes. An outer tube marked 1 which slides up and down and can be fixed by the thumb-screw 1A. This allows the operator to set the instrument at the exact depth at which it is desired to place the first seed and all subsequent seeds can then be placed at an equal depth a second and a third time seeds can be placed at different levels.

The inner tube marked 2 is the canula through this canula the trocar is fixed to transfix the tissues.

At the butt end of the instrument is a breach shown closed into which a magazine in dotted outline marked 3 fits.

In using the instrument the breach is opened and the magazine 3 loaded with a seed 4 to which a thread 5 attached

The depth at which the seed is placed is determined by sliding the outer tube 1 and fixing it by the screw 1a.

The instrument is plunged into the tissue till the shoulder of the outer tube stops it. The trocar is withdrawn the magazine snapped into the breach and the introducer 5 pushes the seed into place the introducer is removed and the magazine raised and loaded again. The instrument can

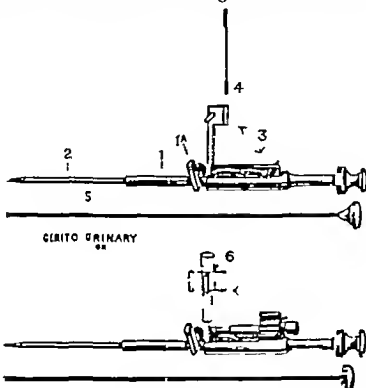


FIG 9

be inserted again by replacing the trocar or partly withdrawn and pushed into another direction.

For multiple seeds a magazine 6 to hold four can be fitted. This revolves like the magazine of a revolver so that four seeds can be inserted in different places all at the same distances from the point of insertion. It is of value to dip the seeds into antiseptic vaseline before loading the magazine.

The instrument is placed upon the market by the Genito Urinary Company, Devonshire Street.

Needles

What are called radium needles are really narrow tubes composed of a wall at least 0.5 millimetres thick they may be made of silver 1 millimetre thick, but platinum is better and is not so bulky. They may be of any length according to fancy and may contain a variable amount of radium. The point is made of iridium and is sharpened by a four or three faced point. The other end of the tube is closed by an eyed stopper which can be screwed on and off. If radium itself is enclosed in the needle the stopper is fixed permanently but if it is to contain emanation or radon this is enclosed in a capillary glass tube and the stopper is unscrewed to insert or remove the capillary tube. Should the dose be above a certain size the needles will be too bulky and a tube will be preferred.

Unless a needle is buried completely by means of a trocar and canula its eye remains flush with the surface. In this case the radium is near enough to the skin to destroy a portion and a distinct pock mark is left which may be visible permanently. In addition to this in a stout person the active portion of the needle will often not reach to the tumour but will act upon the adipose tissue superficial to the tumour and its energy be thus wasted. For this reason I have introduced needles with the same active length of radium but with the eye of the needle prolonged 5 mm. or more so as to avoid this. See Fig. 10 B.

The following are the usual sizes and have now become more or less stock sizes and are recognized by all

27 millimetres containing 2 milligrammes	
44	2
60	3

Larger needles containing 5 milligrammes have been used I believe in the Birmingham General and the Westminster Hospital but I do not know that they possess any special advantage.

From experience I do not recommend needles shorter than 27 mm as they are easily lost and are awkward to insert moreover any movement of the skin will displace them and successive movements will cause them to work out of the

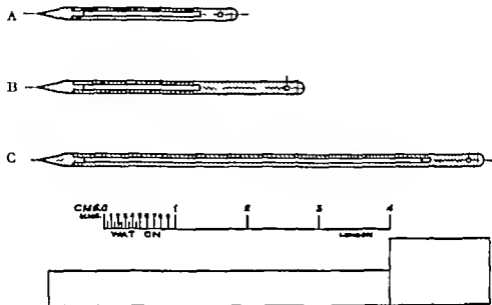


FIG 10

A AND C—ORDINARY NEEDLES. B—WITH LONG SILENT SHANK.

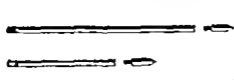


FIG 11—RADIUM NEEDLES



FIG 12—CELLS CONTAINING RADIUM TO BE ENCLOSED IN THE NEEDLES

tissues altogether. They are of use however as applicators to small surface areas such as rodent ulcers or tiny metastases.

When ordering radium for the Mount Vernon Cancer Hospital at Northwood we chose a very wide range of sizes in needles as follows

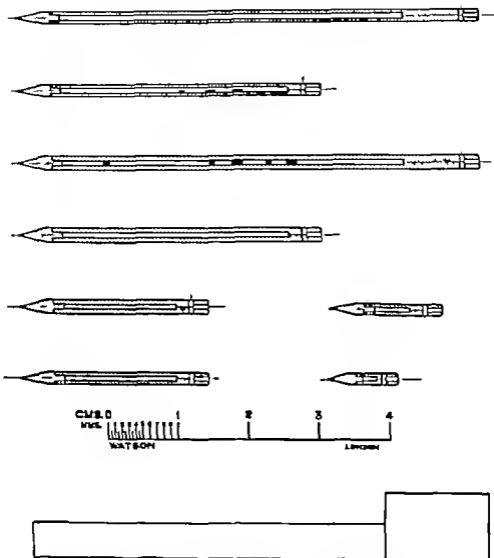


FIG. 13.—NEEDLES ORDERED FOR MOUNT VERNON HOSPITAL.

N. of Nos.	Settling	Actual Length	Length
3	0.6 mm of platinum	48 mm	65
3	0.8	48	65
2	0.8	32	43
2	0.6	32	43
1	0.8	16	27
1	0.6	16	27
0.6	0.5	?	16
0.5	0.5	?	10

Here it will be seen that we have increased the screening to .6 and even to .8 mm of platinum thicker than this the needle becomes clumsy at the same time in the longer lengths the needles are much stronger. In the longer lengths we have adopted my suggestion of a needle with a longer inactive portion at the eye end.

In the very short needles the active length is difficult to give as the needles are so minute. The shortest needles are those special ones suggested by Sir Charles Gordon Watson for use in growths high up in the rectum.

Probably a good deal of experimental work is yet needed before we shall be quite certain as to what is the best pattern of needle to use or right amount of screenage to employ. In Dublin they obtain the long silent shank by screwing a celluloid portion on to the base of the needle.

Protection

Platinum of 5 millimetres thickness is sufficient for the smaller needles but .6 is better for lengths above 44 millimetres as the needle is stronger. Platinum of 5 thickness cuts off 99 per cent of the Beta rays .6 cuts off more so that only a negligible quantity can come through. It has been noted above that at Mount Vernon Cancer Hospital at Northwood we have increased the screenage in a series of needles to 0.8 mm of platinum for experimental purposes. Dr Heyman in Stockholm insists upon an additional protection of lead but it is difficult to understand why he thinks it is necessary.

Precautions in the use of needles

As the needle is really a hollow tube it should be held by forceps only at the end with the solid eye. They must be handled delicately or they will bend and break. The thinness of their metallic wall needs special emphasis for ignorance of this may lead to damage of a needle and loss of the radium. There is so little metal in them that though they can be

photographed by the X rays they are never clearly visible through a thick part of the trunk. This makes them very difficult to find if they are lost in the tissues. I know this to my cost.

To prevent loss the needles should be threaded with fine wire, either silver, copper, brass or iron. If needles containing radium of different strengths are used it is best to distinguish them by different coloured wires. Once the needles are inserted it is impossible to recognize them by their base and equally impossible to remember their exact position unless a note is made at the time. The different kinds of wire however will distinguish them. It is seldom that more than two strengths of needle are used in one case.

If the needles are completely buried in the tumour both ends of the wire should be left long; if one is short it will act as a barb and prevent the withdrawal of the needle. If many needles are to be arranged round a large tumour they may be threaded on the wire and the needles may then be twisted at two inch intervals forming a sort of tiara of needles upon the same wire. Thus I find the most convenient way of mounting a number of needles. The longer the needles the greater must be the interval between them; the flexible wire is no hindrance to their manipulation. See Fig. 36.

In certain positions such as the cheek, the tongue or the palate it may be inadvisable to use wire and a female patient may complain that the ends of the wire pricked on a former occasion and one is tempted to use silk. The needles are difficult to thread unless the silk is dipped in melted paraffin or beeswax which melts just above the body temperature. This is best done by threading the silk through an aneurism needle the eye of which is placed below the surface of the melted wax and the silk drawn through and then pulled through the fingers to free it from excess of wax. It is then cut into lengths. The wax prevents the tissue juices rotting the silk. Linen thread of different colours will do as well if treated in the same way. The silk or linen thread should be

as thick as possible even then if the needle is inserted into tough tissue the thread may cut at the eye.

When ordering needles care should be taken to see that the eyes are rounded. On many occasions the thread has come away in my hand leaving the needle in the tissues. For this reason a 1 per cent novocaine solution should always be at hand when removing the needles to inject into the tissues and render them insensitive while the needle is being searched for every effort must be made to recover the needle at once. I give the advice use wire whenever possible because I have learned to do so by bitter experience.

The needle being threaded is held by an introducer which is a pair of forceps specially made for the purpose. The face



FIG. 14.—FORCEPS TO INTRODUCE RADIUM NEEDLES.

of the forceps is lined by lead and is grooved so as to obtain a good hold on the very end of the needle. The forceps I have designed are shown in Figs 15 and 16 they can hold the needle pointing forwards or at right angles or pointing backwards at an angle. The instrument has a small grip and the handles long so that it can be used through a speculum or protoscope. The little cup on the outside of the forceps is used to press the last part of the needle into the tissues.

The instrument is made by the Genito Urinary Company. If the face of the forceps is not lined with lead the edge of the groove may be so sharp that the material used for threading whether wire silk or linen thread may be cut and the needle left in the tissues.

The groove in the trocar about to be described should also be specially rounded or the material may be cut in the same way.

On withdrawing the needle if the base catches behind a strand of fibrous tissue it may be impossible to remove it painlessly. Wire is stiff enough to allow the base of the needle to be unhitched. Some of my colleagues who use silk or soft materials for their needles usually employ a general anæsthetic to remove them. I never have to

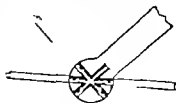


FIG 15

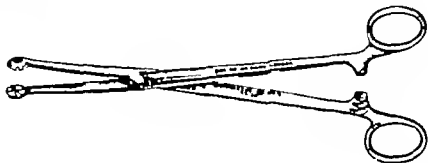


FIG 16



FIG 17—TROCER TO INTRODUCE NEEDLES, WITH SLOT ALONG WHOLE LENGTH FOR WIRE. AUTHOR'S PATTERN

When it is necessary to plant needles deeply into the tissues this must be done through a slotted trocar and canula. The trocar and canula is plunged deeply into the mass the

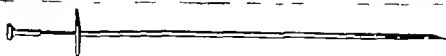


FIG 18—TROCER TO INTRODUCE NEEDLES DEEPLY
SLOT ONLY AT THE END

trocar is withdrawn the threaded needle is placed in the canula and by an introducer thrust into place the slot allow

ing the wire to pass. What has been already said about using silk and using wire may be emphasized again for if the silk breaks with the needle in the depths of the tissues there may be great trouble before it is recovered.

THE INTRODUCTION AND THE PLACING OF THE NEEDLES

The object of the operator is to place the radium in as close contact with the cancer cell as possible so as to produce an equally lethal effect upon all of them. It is impossible to place a straight needle parallel with an irregular surface like the edge of a tumour so that we cannot expect an equal effect to be produced on all the cells as the effect of radium varies with its distance from that cell upon which it acts. All we can do is to bring the radium into apposition with the cell as equally as possible.

Some prefer to place the needles parallel to one another and others advise placing them in a radial manner round the tumour. Obviously the procedure must vary with the growth that is being treated. For instance in a superficial flat growth like a rodent or carcinomatous ulcer upon the skin or mucous membrane the best way of exposing the cells to an equal dose of radium will be to insert the needles at the edge and underrun the area with the needles placed parallel to one another at an equal depth from the surface. Longer needles will be needed for the broader portions and shorter ones for the narrower parts.

On the other hand with a growth situated deeply in tissues such as the breast or which penetrates deeply into an organ as in the tongue the needles must be thrust more or less vertically so as to make them lie parallel to the surface of the growth and they must converge by their points below the growth. Looked at from the surface they will appear to be placed radially.

Each of these methods produces exactly the same effect for the needles are more or less parallel to the actively growing edge of the tumour.



FIG 19—PARALLEL METHOD OF INSERTING NEEDLES UNDER SUPERFICIAL TUMOURS OR ULCERS

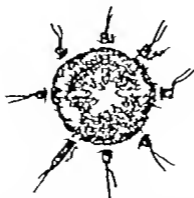


FIG 20—CONCENTRIC METHOD OF INSERTING NEEDLES ROUND DEEPLY SEATED OR PENETRATING TUMOURS

The use of needles is not however merely confined to the treatment of the growth itself they will sometimes be used to attack or protect lymphatic areas and to destroy malignant cells in the lymphatic glands in which case the parallel and the converging methods may have to be combined

Withdrawing the needles

When the needle is withdrawn after a week's insertion a good deal of pus-like material can often be squeezed from the small hole This is quite sterile and is made up of necrotic tissue destroyed probably by the Beta rays The skin round about also suffers for a short distance This is another argument for having a long shank to the needle and the radium near the point

The area may be dressed with dry gauze or with a hot boracic fomentation in any case the tiny hole closes up in a day or two but may be visible for months

The whole area needled may assume a red and congested appearance for a week or more and the skin may be shed An ointment made of white vaseline to which 5 per cent of eucalyptus oil is added is a very good application

Cylinders or tubes

These are tubes which are much thicker than needles They have one blunt or rounded end while the other projects so that it can be held in forceps and has an eye They vary in lengths with the fancy of the operator 1 to 6 centimetres being the extremes the usual sizes being 2 to 4 centimetres the shorter sizes are inconvenient and difficult to keep in place Their diameter ranges from 0.9 to 2.2 millimetres Their walls are either of platinum 1 millimetre thick or silver 2 millimetres thick

They may contain 5 to 100 milligrammes of radium or the end may be made to unscrew so that an equivalent amount of radon or radium emanation may be inserted in a glass tube

Several forms of tubes have been introduced with the object of making the radium act more powerfully on

the malignant cell. The sleeve tube is a tube in which the screening is much reduced at the end so that the rays are more active at this part. In the window tube there is a slot in the side of the tube and very little screening at this point. The idea being that if the growth is only on one side of a hollow viscus such as the cervix the window might be placed at that side and more effect obtained. These are not much used now.

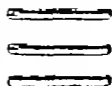


FIG. 21
TUBES CONTAINING
RADIUM

Mr. Pinch of the Radium Institute brought out an hour glass shaped tube for oesophageal strictures the end however is too large for easy insertion and the one made for me (see Fig. 23 C) is better and is suitable for all forms of stricture whether in the oesophagus colon or rectum.

As a tube carries a larger dose than a needle it requires to be used with circumspection and knowledge. The larger the dose the shorter the period it should be used. At first large doses were used for periods like 12 to 24 hours but during the past few years the amounts of radium used have been getting smaller and the time longer and doses such as 100 milligrammes are I believe now seldom given. Four years ago when choosing tubes for St. Mary's Hospital we took 45 and 50 milligrams as good average amounts during the last year I have been working mostly with 30 milligrammes and giving longer exposure up to four days in some cases. The last tubes we ordered for the Hospital were only 25 milligrammes.

Large doses must not be used near the skin or mucous membrane or near bones or near teeth if there is any sepsis. They are not much use in the centre of a large tumour as it probably only consists of degenerating cells while the actively dividing outer edge is the truly malignant part. They may however be placed with advantage under tumours in their close proximity.

The tubes I use now are enclosed in silver containers having an iridium trocar point. The wire attached to each

container is knotted at 1 inch intervals. The container may be thrust far under a breast till near the opposite margin of the tumour and withdrawn one inch each day so as to act upon a large portion of the under surface of the tumour. If tubes of different strengths are used different coloured wires should be attached to them and a note made at the time. The tube with the heaviest dose should ordinarily speaking be removed first.

Tubes and needles act well together the needles being placed round the tumour in a radiating manner and piercing its substance from the surface while the tubes can be placed under the tumour far from the skin. Here again it is better to use wire as its stiffness will prevent the tube working to the surface and burning the skin while with silk or thread anything may happen.

Applicators

There are appliances which contain radium or a salt of radium usually radium sulphate as the element must be spread out over a large surface. Emanations or radon may also be contained in them.

Their size varies from 1 to 30 square centimetres and they may be round square or oblong. The dose they carry depends roughly upon their surface extent. At one time they were the only method we had of applying radium but they are used less and less. Of all the money spent upon radium at the Mount Vernon Cancer Hospital at Northwood not a single penny has been spent upon surface applicators. This illustrates the change which has come over our ideas with regard to the use of radium during the last few years. Special applicators called spatulae attached to a handle have the surface faced with radium salt and the back heavily screened they are useful for growths on the eyelid where the heavy screening protects the eyeball behind.

Applicators either lightly screened for the treatment of superficial growths or heavily screened so that only the Gamma rays are emitted are employed in deep therapy.

Their special points are dealt with when speaking of skin lesions. When it is wished to expose only a small area such as a rodent ulcer to the rays the part can be covered with lead rubber sheeting in which a hole is cut just sufficient to expose the ulcer. The applicator can be fastened in position over the opening with strapping.

Nowadays surface applicators are nearly all made for the special object that the surgeon has in view.

For instance for a small surface short needles are inserted into little frames either one needle into each compartment or into every other compartment depending upon the dose



FIG. 22.—FRAMES TO BE FILLED WITH NEEDLES
AND USED AS APPLICATORS

required. A piece of wire is threaded through the needles and frame to prevent loss and a silk thread can be left to be fastened to the skin if needed. To prevent exudate getting into the frame it is best to dip it when loaded into melted paraffin wax and remove it after it has become hot. The frame can also be fixed to a layer of Columbia paste which is described below. If screening is needed behind the frame a small piece of lead rubber or lead sheeting 1 millimetre thick can be cut to the required size and the two dipped in the wax so as to fix them together. This is important in the mouth where radium is being applied to the cheek and the teeth and jaw require protection.

For mucous surfaces such as the cheeks, palate and lips a small frame applicator can be loaded, screened, immersed in wax and supported in place by ordinary dental modelling

compound softened in hot water The assistance of a dentist or a dental mechanic is most valuable in such cases.

Columbia paste for surface radiation

Surface application except for special situations has given place to a technique developed at the Radium Institute in Paris Here after much experimenting Columbia Paste was introduced It consists of

Beeswax 100 grammes

Paraffin (melting at 62 C) 100 milligrammes

Fine wood sawdust 200 grammes

These ingredients are melted together and run into flat moulds producing squares of yellow looking wax 10 to 15 millimetres thick.

In the process of cooling the sawdust sinks to the bottom so that one side of the paste is dark brown and the other side yellow The dark side is applied to the skin

This preparation is eminently suited to the purpose as when heated to 48 C becomes soft and dough like It can be cut into pieces which are moulded to any surface of the body and being light a large mould is not irksome to wear Radium needles are heated and laid upon the yellow side of the paste and sink a little way in they may be fastened on if necessary with plaster

As many needles as desired may be applied from $\frac{1}{4}$ to 2 milligrammes in strength the weaker they are the closer they may be placed but 1 centimetre apart is the average distance This method of treatment is suitable for miliary metastases after breast operations cervical or inguinal glands and brain tumours as time goes on it will be used more and more for deep seated growths It can be used with advantage after needling but should not be used at the same time as secondary radiation may be set up by the buried needles and a local overdose received, with destruction of tissue Its disadvantages are that it is wasteful of radium as the patient does not get the full dose a large amount of radium is required and that for a long time so that only a

few patients can be treated. Its advantages are that if radon be used it can be employed in the out patient department and requires no operative treatment.

Distance irradiation

This is known as Tele-Curietherapy and is really developed from the last. Blocks of wood or paraffin up to 10 centimetres in thickness are fixed to the outer surface of the mould at considerable distances from each other and tubes containing large doses of radium applied to the blocks. Paris is the home of this method and I have seen 5 grammes of radium applied there to one patient. This requires a special room and enormous apparatus to manipulate the 150 pound lead box containing the radium. Special bombs are also being tried for very short periods of time in Paris, Brussels and this country but it is too early to speak of their effect. It is however curious to see apparatus for massive doses newly introduced in the very Institute which has insisted on lessening the dose and spreading it over a greater time.

It only shows what an experimental stage of treatment we are still in.

No further reference need be made to this method as at the moment we are handicapped by the lack of radium. Steps are however being taken to remedy our defects and it is hoped that we shall have all the radium we require in a short time. Indeed the fear is that we shall possess more radium than we have surgeons who understand its use.

Economy in the use of radium

Radium is so expensive that any method by which its use can be made more economical must be welcomed.

All sorts of instruments have been devised to apply radium to the different areas of the body. There are applicators for instance containing anything from 5 to 150 or even more milligrammes of radium. As applicators they are good but they are no good for anything else and 50 milligrammes of

radium locked up in an applicator represents £600 which lies idle when the particular applicator is not being used. Again a tube designed for use in carcinoma of the cervix is useless to insert into a stricture of the oesophagus or rectum. Thus an institute dealing with radium may have many instru-

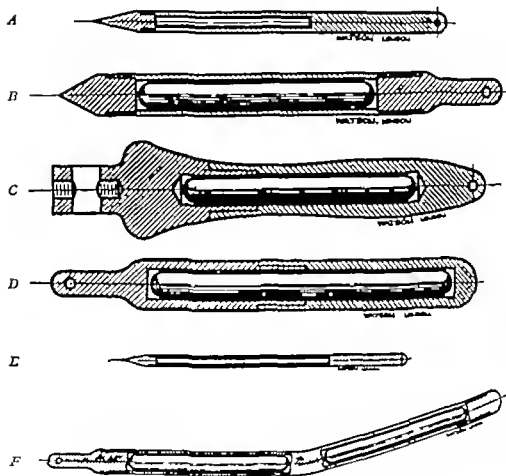


FIG. 23.—NEEDLES AND SPECIAL CONTAINERS

- A Needle with long silent shank.
- B Container for thrusting under tumour as in the breast.
- C Hour-glass container for stricture of oesophagus or rectum.
- D Special container for cervix
- E Long-shanked needle containing two cells.
- F Uterine container for cervix and body of uterus.

C, D and F are not all drawn to the same scale as the tube
contain will fit each and all

ments all representing large sums of money and useless for anything except what they were especially designed for

The use of the frames which have been mentioned has done away with surface applicators as needles which can be used elsewhere make admirable applicators

Unfortunately for institutions which have a large number of these applicators it is an expensive process to extract the radium from its compound and transfer it to needles

For the special instruments such as tubes the matter can also be simplified. Each dose of radium whether 30 40 or 50 milligrammes is made up in thin platinum capsules or tubes with walls of 1 millimetre thickness This can be enclosed in thin tubes of silver of 1 millimetre thickness specially made to fit into the rectum the cervix or the oesophagus The combined thickness of the two metals makes up the screening needed for the radium in this way radium can be used much more extensively than at present I have arranged all my tubes to be used in this manner It is essential that the thin silver tubes be provided with a good screw with a long thread so as to minimise the risk of losing the radium

As an additional precaution the tube is dipped in paraffin of a high melting point and left in till warm on removal the tube is covered with a thin layer of paraffin which renders it water tight and also prevents it becoming unscrewed My silver tubes have an eyed projection through which silk or wire can be passed provided with a screw which enables them to be attached to a long flexible metal rod with a screw at its end so that they can be placed in position through an oesophagus or sigmoidoscope

CHAPTER III

THE EFFECT OF RADIUM ON THE TISSUES

THE effect of radium on the tissues varies with the type of tissue. It has been shown (Dominici) that the sensitiveness to radium increases the more the cells approach the embryonic state also that it is active cells in process of division which are the most affected (Perthes). It has been confirmed (Bergonie and Tribordeau) that sensitiveness to radium increases in proportion to the reproductive activity of the cells. Lazarus-Barlow wrote:

There is no doubt that nucleus or cytoplasm or both may become dropsical or show isolated clear spaces (vacuoles) after exposure to irradiation that the rod like chromosomes become irregular in shape or granular and divide irregularly that the framework of the nucleus instead of showing an even arrangement becomes collected into irregular heaps

and that the cytoplasm may undergo degenerative changes chiefly mucoid. These are early changes. A day or two later if the irradiation has been severe dying and dead cells and fragments of nuclei or cells are seen or a structureless mass of material may be the sole representative of the former living cells.

Canti has demonstrated the truth of these statements in his cinematograph film of the action of radium on malignant cells. It is rare to find mitotic division in normal cells but it is extremely readily demonstrated in malignant cells. This probably accounts for the selective action of the Gamma rays.

The Beta rays seem to have an intense destructive action on all types of cells whether normal or malignant. This is the reason for the careful screening off of the β rays and the purer we get the Gamma rays the better are our results.

On the skin

An erythema of the skin is readily produced by a moderate dose of the Gamma rays and always follows surface radiation. It is accompanied by a slight feeling of inflammation, heat and irritation very much the same as slight sunburn. It is really the first degree of burn. A desquamation or peeling of the skin follows a rather more intense dose. Here the signs of inflammation are more severe, blisters form and the skin is shed; this corresponds to the second degree of burn but differs from it in leaving a weeping surface over which skin does not form for a variable time depending upon the intensity of the dose. I have known two and three months elapse without healing. When healing does take place as a rule the skin is normal in appearance, sometimes however it is deeply pigmented, at other times a whitish or leucodermic patch results and more rarely a port wine stain due to small venous radicles is seen.

This desquamation can be used to gauge the adequacy of the dose received for an underlying growth.

This second degree of burn should really be aimed at but the process should go no further than this. The radium should not be in close proximity to the skin but separated by 15 or more millimetres. If large doses are called for the radium should be applied intermittently, so many hours a day.

More intense dosage with inadequately screened radium or radium placed close to the skin will give rise to a radium necrosis or radium burn. Here the inflammation is so intense that death of the skin and underlying tissues occurs. The part is oedematous and the skin becomes like tough wash leather and the slough may take weeks to separate and months or even years to heal.

Professor Regaud told me of a man who about twenty years ago carried a packet of radium in his hip pocket from the Portugal mines to Paris. He still suffers from the burn which he sustained and which has never healed.

The Becquerel burn sustained by Becquerel in 1901 was

the first indication of the therapeutic action of radium and was immediately turned to use by Besnier. A large number of workers among whom may be mentioned Danlos, Lazarus, Barlow, Mache, Szilard, Masotti, Wickham and Degrais, Czerny, Freund, Bayet, Schiff and others have since worked at the therapeutic action of radium.

Mucous membrane

The effects on the skin are therefore the same as those produced by slight, moderate and severe irritation.

Exactly analogous effects can be seen on the mucous membranes such as those of the oral, nasal or rectal cavities. The epithelial cells under irritation proliferate, become sodden and so whiten and produce the leucoplakic appearance so characteristic of irritated mucous membrane. In addition to which there is an increased secretion of mucus.

Heavier dosage will produce blebs, while more severe still will cause burning or necrosis of tissues.

Malignant cells

These as has already been noted are characterised by their rapid multiplication, forming masses of almost undifferentiated cytoplasm resembling the syncytium of the embryo. It is this embryonic condition which renders them so sensitive to radium.

In Canti's film as soon as the radium is applied the cells become stationary, multiplication ceases and withering of the cell begins. Malcolm Donaldson has demonstrated the same thing in cases of cancer of the uterus after treatment. Disorganisation of the chromosomes takes place followed in a short time by disintegration of the cells themselves.

The stroma

Various workers headed by Roussy have endeavoured to show that the reaction of the stroma plays an important part in the action of radium on the malignant cell. The general trend of thought at the present moment, however, is against

this view and it is widely held that the stroma is a passive agent

On function

The function of certain organs can be severely upset by the presence of radium especially is this the case in reflex action. Radium in the rectum can materially upset the urinary functions and cause frequency. Radium in the bladder may cause irritation of the rectum. Radium applied over the stomach may cause vomiting.

On the tissue generally

Radium apart from the changes mentioned has an effect which is little understood upon the tissue. This change only becomes a factor after a latent period of time of varying length. It is seen where necrosis suddenly appears months or years after in the tissues previously radiated. The necrosis is determined by some slight injury, a too hot bath, the rubbing of false teeth, or some other quite trivial cause. Operations of course can not be performed on areas previously radiated after this latent period has elapsed as the incision will show no sign of healing.

Many experiments on ova, spermatozoa and embryos show that these curious unknown changes can be transmitted to the second and even the third generations. Perhaps the most significant of these phenomena was noted by Murphy who showed that radiated mice were rendered immune to cancer grafts to which they were previously susceptible.

This opens up an entirely new field in radium therapy into which at present few have ventured. Many other experiments might be quoted showing that radium has effects on the endocrine system the significance of which we are at present quite ignorant.

Effects on the patient

Unlike deep X ray therapy radium produces few baneful effects upon the patient. Especially is this the case when

comparatively small doses are given as in oral or cervical cancer

In cases where large doses are applied to the larger serous cavities as in surface radiation of the chest or abdomen a certain general effect can often be noted. A good deal will depend upon the nervous temperament of the patient.

The pulse and respiration rates may rise slightly and remain up for a week or more. There is said to be a diminution in the quantity of the urine and this may be followed by a polyuria in those in whom a beneficial effect is expected. Depression, malaise and lack of appetite may be met with.

In some cases toxic effects may be seen such as subnormal temperature, vomiting and fall of blood pressure. I remember one lady who vomited for three days continually after the application of a cuirasse to her chest. This was at once relieved on removing it. On replacing it two days later she had no trouble at all.

Loeper and Tonnet attempt to explain this as being due to protein shock from the rapid disintegration and absorption of tumour tissue. They find an increase in globulin, lipoids of glucose in such cases.

I do not believe that this is often the cause as in my cases the effect of the radium was immediate before breaking down of the tumour could have taken place. I have never seen it after inserting needles into a breast tumour where breaking down might well be expected. I lost a case of sarcoma however see p 162 which might have been due to this cause.

CHAPTER IV

ORAL CARCINOMA

IN oral carcinoma, whether of the tongue the palate or the cheek there are certain preliminary measures to be strictly adhered to without which success is not to be looked for

What is termed the oral toilet is most important This is the elimination of sepsis from the mouth On placing a strong light behind the gums any teeth which show a dark area of congestion round their roots should be removed The other teeth should be scaled and adequately cleaned No plates or metal bridges should be worn during treatment metal fillings even are undesirable but sometimes cannot be avoided In Paris the wearing of plates is prohibited for some months after treatment as well

An attempt should be made to diminish any sepsis in a carcinomatous ulcer by painting it with carbolic or pure formalin while an antiseptic mouth wash should be used frequently The use of the knife or of diathermy is advocated by some but I cannot recommend either especially the latter

THE TONGUE

There is only one form of carcinoma of the tongue the squamous celled epithelioma This is typical of the epidermoid epithelioma group of Professor Regaud which according to him is so radiosensitive as to be easily killed by radium Hence it is that we get such good results in dealing with the primary growth. Carcinoma of the adenoid type is practically unknown Whether the carcinoma is of the ulcerous or fissured type the nodular type or the papillary type seems to make little difference. Nor has any great difference been

noted between the atrophic and the rapidly growing type if there has been a difference it is that the more rapidly growing more malignant and therefore more embryonic the type the easier it is to destroy

We are confronted however by two problems very different from each other The one is how to deal with the primary growth in the tongue and the other with the secondary infection of the glands in the neck.

The important point to remember about the primary growth is its method of spread The growth may appear to have only a small superficial area and yet beneath it is



FIG. 24.—SMALL EPITHELIOMA ON SIDE OF TONGUE.
Section down the middle shows the deep penetration of the growth.
(St Mary Hospital Museum 31 77113)

burrowing deeply towards the base of the tongue and the hyoid bone It is impossible to gauge the depth to which the ulcer penetrates An ulcer with a fissure in it if laid out flat would have a surface area of anything between three and five times what appears on the surface.

The local recurrences in the mouth after operations are really parts of the original growth which have been overlooked at operation

It is usually the margins of the tongue which are affected but the base may be invaded and can only be seen well with a reflected light and a mirror or the growth may be where the anterior pillar of the fauces joins the tongue In which case

the growth rapidly spreads on the palate. The sulcus between the gum and the tongue is a most awkward situation owing to the close proximity of the jaw. Ulcers which have spread to the side of the jaw and to the gum are the most difficult to deal with.

The primary growth in the tongue should be treated before the glands but there is no harm in opening the attack upon the glands at the same time if seeds or needles are to be employed for both.

Seeds

The insertion of radium by means of seeds has been much used in America but owing to the difficulty of getting the seeds has not had much vogue in this country. I took one man to the Radium Institute and under the advice and with the assistance of Dr. Gosse inserted seeds. The man did well for a time but the dose was not sufficient and there was a recurrence. Another most unfortunate result was that the glands on both sides of his neck swelled up. I thought it was inflammatory due perhaps to sepsis but it however proved that they had become suddenly and heavily infected with carcinoma and he died shortly afterwards. This is the only time I have seen anything analogous to this occur.

In using seeds the rapidity of their deterioration in strength must be kept in mind and an adequate number inserted. One seed will probably deal with a cubic centimetre of tissue. An adequate number of fresh seeds must be inserted as they lose their strength so rapidly.

Needles

For primary growths small doses of well screened radium in needle form should be employed for a week or more. The older method of using large doses in the endeavour to give a knock-out blow in a short time is now everywhere abandoned.

I usually use needles of 20 to 27 millimetres in length containing either 1 or 2 milligrammes of radium screened by 5 millimetres of platinum. The needles should be inserted

round the ulcer or nodule in such a way as to point downwards and inwards towards the hyoid bone and should converge slightly as they pass into the tongue. In this way the cone shaped area is enclosed for its whole depth between the needles. The needles need not be nearer each other than 2 centimetres. If weaker needles say of 1 or $\frac{1}{2}$ milligramme of radium are used then they must be placed closer together. Needles shorter than 15 millimetres I find are too short for convenience.

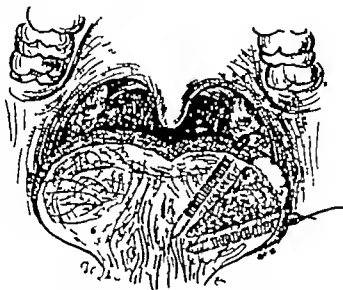


FIG 25 — NEEDLES ARRANGED ROUND A DEEPLY PENETRATING GROWTH OF THE TONGUE

They are fixed in position by a needle and thread

Stanford Cade recommends needles of only 10 millimetres in length and says they should be completely buried in the tongue such needles however cannot reach the depths of the organ. The tongue moreover being a purely muscular organ the needles may protrude and may even slip out. Using longer needles is a great advantage.

If the growth is in the base of the tongue the forceps shown on p 25 will be found most useful for inserting the needles.

For growths in the base of the tongue or floor of the mouth I always insert needles of 37 to 44 millimetres with the active



length well towards the point, through the skin to the jaw into the body of the tongue.

The needles should be threaded either with thin wire or thick silk. If with thin wire a strand of Japanese catgut is threaded through the first twist of wire and a small curved needle mounted on one end. The radium needle is inserted into the tongue, the needle on the Japanese silk-worm gut is made to pierce the tongue near where the needle disappears, the silk-worm gut is tied and cut short. This serves to keep the needle in position otherwise with the movements of the tongue it might work loose. If silk is used, one end is

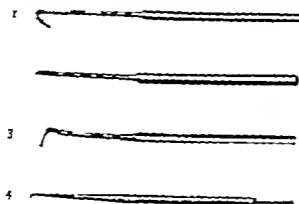


FIG.

1, 2, 3 Instruments used for pushing the rim of the mouth back to level of the mucous membrane. 4 Forceps to hold the needle.

threaded through a needle and the same thing done on the other side being cut short. When all the needles are in position the wire or the silk is threaded through a small rubber tube and brought out of the angle of the mouth and fastened to the cheek. It is said that silk is the more comfortable but I have not found any great difference both in fit and use.

The diet for the week the needles are in place must of necessity be of fluid character. Mouth washes should be used frequently.

The result of treatment on the growth in the tongue is most striking and is visible at the end of a week. When the needles are removed the side of the tongue is swollen and

larger than it was the ulcerated surface if one be present is smooth and oedematous and has lost its malignant look. It is covered with a white film which may not be confined to the ulcer but may spread over the adjacent surfaces of the tongue gum cheeks and palate if they have been in close contact with the radium. It is due to a thickening of the irritated mucous membrane and to a deposit of fibrin and is a little alarming at first but afterwards one learns to recognise it as evidence of effective radiation and to use it to gauge the dose received.

The swollen condition of the tongue may remain for a long time while the surface of the ulcer gradually becomes clean and heals up the epithelium rapidly growing in over the ulcer so that in a month to six weeks time the tongue is still large and oedematous looking but otherwise normal. Moreover the mobility of the tongue has almost been recovered and will still improve. Another effect of the radium which will surprise the patient is that the hair of the moustache and beard will cease to grow for some weeks on the affected side.

Dosage

It is almost impossible to state dosage with any accuracy experience alone will teach that one of the most extensive growths I ever saw disappeared after the insertion of 7 needles (4 of 2 milligrammes and 3 of $\frac{1}{2}$ milligramme) at wide intervals and burying a 5 milligramme tube in the tongue from the skin surface. The total dose being 2160 milligramme hours.

A much smaller dose will suffice for smaller growths.

Mr A seen in January 1926 for a cancerous ulcer on the right side of the tongue which he had known of for two months.

The ulcer was typical the size of a shilling some enlarged glands in the neck under the jaw.

12th January 1926 Seven 2 milligramme needles 27 millimetres long were inserted round the ulcer pointing down towards the hyoid bone. They were stitched in position and removed on the seventh day equalling 2352 milligramme hours.

The pathologist reported carcinoma with mitotic figures.

A month later a block dissection removed the glands from the neck, only one of which was infected. In April there was no sign of disease. He reports regularly and has never needed other treatment.

This case is quoted as typical of many successful cases. I have known few cases of carcinoma of the tongue fail to disappear with radium.

I have known two cases where apparently metastatic growths have appeared in other parts of the tongue after complete disappearance of the primary ulcer and one case E which recurred locally showing that all the malignant cells had not received a lethal dose.

Mr E. aged 59 sent by the late Dr Windle 3rd November 1928

History Had had a sore tongue for many years and been under treatment for it since 1916 smokes $1\frac{1}{2}$ ounces a day. He knows there was an ulcer some 12 weeks ago. He had syphilis 20 years ago and has had ulcers upon his head but was treated for this by his doctor.

Examination showed hard ulcer occupying the whole of the half of a fixed and swollen tongue. The ulcer was prominent and fungating high above the surrounding level, it bled as he talked but gave him no pain. His breath was extremely foul his speech indistinct and he slobbered continually. While waiting for admission to the Freemasons Hospital he was given a course of colloidal lead and his teeth were seen to and an effort made to clean his mouth.

On the 21st November 1928 it was noted that the ulcer was spreading rapidly and had now crossed the middle line of the tongue it bled continually. No glands could be felt but his teeth were still very bad. Only 4 needles of 2 milligrammes and 3 at $\frac{1}{2}$ milligramme were available. These were inserted and were reinforced by a 5 milligramme tube which was thrust up into the tongue from below. He had the very inadequate dose of 2160 milligramme hours which was not nearly enough for such a large area. Nevertheless the effect was immediate he went out delighted on 1st December with only a small contracting ulcer under the tongue. His salvation and bleeding had stopped and his speech was distinct.

On the 18th January 1929 he was readmitted and four needles (1152 milligramme hours) were placed under the small slough

which was all that remained of his trouble. He got quite well. In June there was a local recurrence and he was readmitted and had a dose of 2492 milligramme hours into his tongue some needles being inserted below his chin in the region of an enlarged submaxillary gland. The reaction was good and it was decided to perform a block dissection. He was not a good subject for a long operation being very fat. His teeth were to be seen to previously and he came to Hospital to have them removed. He was anaesthetised for their removal and died suddenly under the anaesthetic.

I think this was the largest carcinoma of the tongue of short history I have seen and yet it completely disappeared after a comparatively small dose of radium.

The glands in the neck

The glands in the neck concerned in the drainage from the tongue are the submental glands for the tip these also receive lymph from the lower lip. From these glands lymphatics may pass with the anterior jugular veins down to glands on either side at the root of the neck the majority of the lymph however goes to the submaxillary glands.

The submaxillary lymphatic glands drain the middle portion of the tongue and are situated in and around the submaxillary salivary glands they drain in turn into those glands lying over the bifurcation of the carotid. The lymph from the back of the tongue passes outwards through the middle constrictors of the pharynx into the deep aspect of the parotid and thence to the carotid lymphatic glands. These in turn pass down to the root of the neck on each side. The lymph from the tonsils and palate takes much the same route.

When glands upon one side of the neck begin to get blocked the lymph from the tongue can pass across the middle line and flow through the glands upon the opposite side thus accounting for the infection of both sides in advanced cases.

Lymphatic infection takes place probably earlier in the case of the tongue than of any other organ as the tongue is a

muscular organ always moving and pumping out its lymph by its muscular movements

All radium workers agree that primary carcinoma of the epidermoid epithelioma type is exceedingly easily killed by radium in the primary growth but unfortunately as soon as these epidermoid epithelioma cells leave the primary tumour and reach the glands they are much more difficult to deal with Why this should be so is not yet explained To

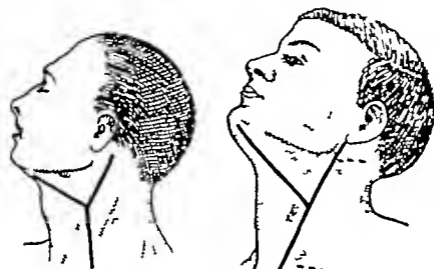


FIG 27 —INCISIONS FOR REMOVAL OF GLANDS

Interrupted line indicates possible extensions Dotted line on jaw shows the removal of the angle

(Fitzwilliam, Temple and de Droux Oxford Medical Publications.)

begin with they are deeper from the surface they cannot be got at so surely as the primary growth and it may be that it is more difficult to make out which glands are infected and therefore which glands exactly should have radium applied to them

Treatment of the glands by block dissection

If I am sure that there are infected glands present when I am dealing with the primary growth in the tongue I always place needles round and into the affected glands and leave them in for the same time as I leave the needles in the tongue even longer in some cases

Some two or three weeks later when the inflammatory reaction in the tongue is passing off a block dissection of that side of the neck is performed. An incision is made exposing the common carotid low down and a temporary ligature is tied round it so as to control the whole blood supply of the region. After this the incision is prolonged along the anterior border of the sternomastoid muscle. Another incision joins this from under the symphysis of the jaw and another may be made backwards over the posterior triangle. It does not matter whether the dissection is made from above downwards or from below upwards the muscle the internal jugular vein and the whole of the lymphatics including the submaxillary gland are removed. This will include division of the facial vessels at the margin of the jaw and perhaps the lingual artery also. If the lesion is far back in the tongue it is better to saw off the angle of the jaw as this gives a much freer access to the region and the lower part of the parotid together with the lymphatic glands enclosed in it should be removed. It is as well to divide the main lymphatic trunks above and below with the cautery as this prevents cancer cells being shed into the wound from the lymphatics.

After the dissection is completed and the haemorrhage stayed the temporary ligature can be removed from the common carotid artery.

Needles containing $\frac{1}{4}$ or 1 milligramme of radium are then placed over the raw surface and the wound sewn up the ends of the wires attached to the needles being brought out between the stitches.

The needles should be removed upon the third day if left in longer there is a risk that they may delay healing.

Treatment of glands in the neck by radium Needles

If it is decided to treat the glands in the neck by means of radium the needles should be arranged so as to lie as close to the glands as possible. It is not always easy to get the needles to lie underneath the glands though this should be

tried. But many of the glands are attached or in close proximity to the internal jugular vein. Whether the needles do any harm if they pierce the vein I do not know but to begin with one had considerable qualms in thrusting in needles close to the vein. These however have passed. I have never seen any trouble follow the insertion of needles and I am equally certain that many I have inserted must have wounded the vein.

In a large mass of glands I plunge needles into the mass itself as well as insert them close round the border. I think it is well to do this and now have no fear that cells will escape through the puncture.

Once carcinomatous cells have gained the tissue outside the gland capsule and are infiltrating far and wide I do not believe that needles will produce a permanent cure.

Mrs P. admitted to St Mary's 11th April 1926 with a cancerous ulcer of the left side of the tongue spreading down to the floor of the mouth. She was given a course of colossal lead iodide and four 2 milligramme needles (320 milligramme hours) were inserted below the chin to attack the cancer of the floor of the mouth.

On the 24th April 1926 radium not being available the left side of her tongue was removed and later a block dissection was made of the left side of her neck and several infected glands were removed.

She remained well till the following year when glands reappeared in her neck she was seen as an outpatient by the house surgeon as the hospital was closed for additions and when I saw her again her neck was inoperable. She was admitted and the left side of her neck was treated with needles placed around the infected glands. The growth had by this time infected the tissues and though checked for a time began to grow again on leaving the hospital.

Eventually some months after the reaction of the radium had passed off ulceration took place and this opened into the carotid artery causing sudden death.

Nothing we could say altered the conviction of the husband that it was the radium which brought on the ulceration and was the cause of her death from haemorrhage.

Mr T. L. aged 57 admitted to St Mary's Hospital 27th March 1928 with a pimple on right side of the tongue which had

been diagnosed and treated as a chronic inflammation. Microscopic examination of a piece removed proved it to be carcinoma. No glands were felt. Needles 27 millimetres long were inserted round the area and 2016 milligramme hours given.

The ulcer completely disappeared

Readmitted 15th April 1929 with a small hard fixed gland behind the angle of the jaw. Eight needles containing 2 milligrammes were inserted round the gland and 2656 milligramme hours given.

14th June 1929. No glands to be felt.

Readmitted 11th July 1929 with a suspicious hardness in neck. An incision made and the sternomastoid retracted and needles laid along the vessels and among the glands. The wound was completely closed. A week later the needles were withdrawn without opening the wound. 2160 milligramme hours being given.

6th September 1929. No sign of trouble in neck.

This is the only patient I am sorry to say who out of a series of several has survived in whom needles have been relied upon to control the glands in the neck and for this reason I now advocate strongly a block dissection in all cases. Radium needles can be laid in place at the same time to make doubly sure.

S. L. male aged 65 sent me by Dr. Walton with carcinoma of the tongue.

History. Noted soreness of tongue and stiffness of swallowing three months previously. Then a sore appeared on the left side of his tongue and has spread rapidly.

On examination there was a crater like oval ulcer $\frac{3}{4} \times \frac{1}{2}$ an inch, with rough everted edges on and rather under the left margin of the tongue. Teeth in a bad condition. Enlarged and tender glands in left submaxillary and in the carotid region. Tongue very indurated. The surface of the ulcer was uneven ragged and covered with a yellow slough.

Seven 2 milligramme needles were placed in the tongue round the ulcer. Two were inserted into the tongue from the skin margin through the submaxillary region. He was given 2899 milligramme hours.

Pathological Report. Squamous celled carcinoma of tongue moderate degree of keratinisation and numerous mitotic figures present.

The ulcer practically disappeared only a small linear slough was left under the tongue.

Readmitted 23rd January 1929 with swelling under the left jaw and in the carotid region. A white scar on the tongue. He was given 1715 milligramme hours by needles inserted into and round the glands.

Readmitted with a hard tender lump in the left side of the neck thirteen needles inserted and 48 6½ milligramme hours given with a good reaction. Ulcer appearing on the tongue again very foul.

4th June 1929 Dr Walton wrote to say he had had a hæmorrhage from the tongue and was very weak.

Readmitted 15th June 1929 and needles placed both in neck and tongue and 2431 milligramme hours given. He had hæmorrhage and lost half a pint of blood while in Hospital. He was sent home in ambulance to die.

I heard in October he was better again.

This is the one case I have had where the tongue refused to clear up and where the primary growth seemed to be causing death.

Lately I have modified the technique combining operation and needling. The glands have been exposed fully and needles inserted as thought necessary. This allows far more accuracy in the placing of the needles and the results have been correspondingly satisfactory that is to say the glands have disappeared completely. The needles must be placed as far from the skin as possible or the skin will suffer and healing will be delayed. It is too soon to say much of the ultimate result of this method.

Surface radiation

This requires a considerable amount of radium for a long period and in this country our lack of radium has sadly hampered us in developing this branch of surgery. In Paris where radium is almost unlimited it has been practised with great success. Mr Stanford Cade at the Westminster Hospital has been able to carry out this line of treatment. My supply of radium has only lately enabled me to follow it in a systematic manner. The ample supply of radium we hope to have at our disposal at the Mount Vernon Cancer Hospital will enable us to explore every method of treatment.

Radiation can be carried out either without doing a block dissection or before or after it each method has its advocates I can only say with regret that I have lost a series of patients during the last two years with spreading infiltration of the tissues of the neck I believe because I refrained from performing a block dissection and trusted too long to needles.

A mould of the neck of Columbia paste 15 millimetres in thickness is made passing outwards well over the posterior



FIG 28 —COLUMBIA PASTE COLLAR APPLIED TO THE NECK
Needles shown in position The lead sheeting is pulled aside

triangles of the neck. The glandular area can be marked on the mould by a pin. Needles containing $1\frac{1}{2}$ to 2 milligrammes are heated and sunk in the outer side of the paste and should overlap the marked area they are covered with plaster for greater safety. The areas not needing radiation can be screened off either by lead rubber or thin lead sheeting 1 millimetre in thickness this is seldom necessary. A sheet of lead is spread over the outer side of the mould and the

whole fastened together by plaster about 30 to 50 milligrammes should be distributed over each glandular area making a total of 60 to 100 milligrammes if both sides of the neck are to be radiated. The patient wears the mould either continuously for 10 days or for 16 to 18 hours a day for at least two weeks so that if he wears the mould for 18 hours daily for 14 days he receives a dose of $(30 \times 24 \times 18)$ 7560 milligramme hours over each area. He does not really get the whole of this dose but that is how it is calculated.

A second course of treatment can be given if necessary but it is always our aim to give a lethal dose the first time.

The whole area radiated will become red and irritated and in many cases the skin will desquamate widely and may take some time to heal. It should be dressed with a soft ointment spread upon gauze and covered with a bandage.

CHAPTER V

THE PALATE

THE palate is not often the site of malignant disease but when it is the patient usually comes for treatment early. If taken at this stage one can almost guarantee a cure. Infection of the glands is late as the palate does not move and continually pump out lymph as does the tongue. The type of carcinoma is the pure epidermoid epithelioma which we know is easily destroyed by radium.

I think it is wrong to increase the vascularity of such growths and ulcers by the application of diathermy previous to applying radium. Infection of the glands must be more common after such a proceeding.

A local anaesthetic will often suffice in any but very nervous patients. Infiltration of the tissues should be carried out by $\frac{1}{2}$ per cent of novocaine to which 2 minims of adrenalin to the $\frac{1}{2}$ has been added. If desired a pad of 5 per cent novocaine or cocaine may be applied to the surface and held in position as well.

Seeds

Carcinoma of the palate can be treated by inserting seeds round the growth but these are not easy to obtain and I have generally employed needles.

Needles

These may contain $\frac{1}{2}$ or 1 milligramme and I have used 2 milligramme needles with success. The needles are inserted between the ulcer and the bone as a rule from before backwards and are stitched in position. They should be placed parallel about 1 centimetre apart. If the needle is not



Mr. G. eighteen months after radiation of a
carcinoma of the palate

(See p. 57)

long enough to reach across the ulcer other needles should be inserted from behind forwards so as to cover the area. Forceps such as those shown on page 25 which can hold the needle pointing backwards are most useful for this. No force must be used the needles must be coaxed between the mucous membrane and the bone. If strong doses are used a screen of 1 millimetre should be used to protect the tongue. It can be fixed with dental modelling wax and attached to the teeth of the upper jaw. A dental assistant is a great help on such occasions. This shield may be removed and the mouth washed out with an antiseptic mouth wash when required. The needles are left in for three to six days.

W. G. male aged 75 admitted to St. Mary's Hospital 13th July 1928 with an ulcer the size of a sixpence with hard rolled-over edges on his palate hard to the left of the middle line.

History. He had complained of pain in the roof of his mouth chiefly on the right side since the month of May but did not notice the sore till later. Two 2 milligramme needles were coaxed between the mucous membrane and the bone under the ulcer and a dose of only 224 milligramme hours was given. In three weeks time the ulcer healed and he has reported himself regularly for examination since.

Pathological Report. Squamous-celled carcinoma.

Surface radiation

Radium applicators were first made in the form of spoons with the radium at the back while the part next the tongue was protected by lead. The same sort of apparatus reversed was used also for the tongue. The patient held the spoon in the mouth. These methods are out of date. Now the dental assistant takes a mould of the upper jaw as if to fit a tooth plate. A cast and plate lined by lead is made and the area of the ulcer removed or pushed out so as to contain the radium needles which can be fixed in modelling wax or grooves can be made opposite the area of the ulcer and needles fastened in the grooves by silk which passes through perforations in the plate.

When the plate is ready it is fixed in position and worn night and day being removed periodically to rinse out the mouth. The plate may be worn for as long as is thought fit if worn continuously six to eight days is the average time depending on the extent of the lesion. If worn intermittently for a few hours a day the treatment may be spread over a matter of weeks. If necessary the needles may be rearranged during that time so as to give a more uniform radiation but this is seldom necessary.

CHAPTER VI

THE CHEEK AND LIP

LIKE all squamous celled growths carcinoma of the cheek reacts readily to radium. In the majority of cases the growth is seen early before it has spread deeply and invaded the muscles indeed the superficial spread of the growth is one of its most marked features

Seeds

Seeds give good results if placed around and under the growth but they are not easy to obtain needles are handier and therefore more often used.

Needles

The length of the needle will depend very largely upon the extent of the ulceration. Small ulcerations may be treated with needles of 15 millimetres in length there are many disadvantages of using short needles see p 20. I usually use needles of 27 or 37 millimetres

The needle is thrust in near the front edge of the ulcer and made to traverse the tissue as close beneath the ulcer as possible. If the needle is too short to pass right across the middle of the ulcer either a longer needle should be used or a needle of similar length thrust in from the other side. The needles should be stitched in position and the threads fastened to the outer side of the cheek with plaster. If the ulcer is at all large and the quantity of radium considerable a layer of lead 1 millimetre thick should be fixed to dental modelling wax or vulcanite so as to protect the two jaws

I. J. C. aged 58 admitted to St Mary's 13th March 1929

History Six weeks previously noticed ulceration of the inside

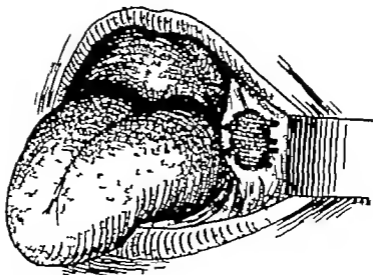


FIG 29 —INSERTION OF NEEDLES UNDER A GROWTH OF THE CHEEK
The threads are not shown

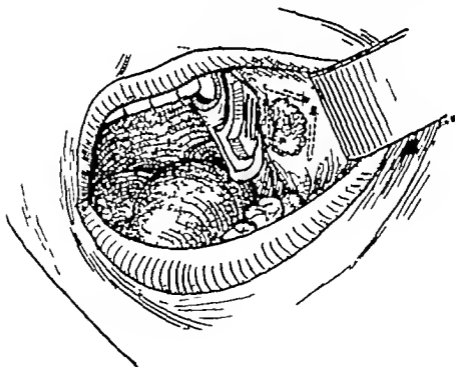
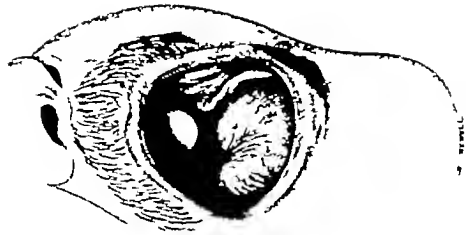


FIG 30
NEEDLES INSERTED ROUND A GROWTH OF THE CHEEK AND NEEDLES
IN A BLOCK OF PARAFFIN ATTACHED TO A LEADEN DENTAL PLATE
The needles are sunk deeply in the paraffin and could not be seen
as depicted in the drawing.



Mr F J C before operation 13th March



Mr E. J C after operation 3th June
(See p 61)

angle of the left side of the mouth and inner side of cheek. This has spread steadily. He had some teeth removed.

On examination. An ulcer about $1\frac{1}{2}$ inches square invading both lips and the cheek. No glands felt. A piece removed proved to be carcinoma. Two needles 27 millimetres long containing 2 milligrammes of radium were inserted under the growth and he was given a dose of 1312 milligramme hours.

The ulcer completely healed. He reports himself regularly for examination. (See Coloured Plate.)

Surface radiation

This is an excellent plan but rather more difficult to carry out. A plate to fit the upper jaw is made of wax or vulcanite and lead 1.5 millimetres thick is attached to it to protect the jaw. To the surface facing the ulcer a thin piece of paraffin or dental modelling wax is fixed, and the radium in needle form is embedded deeply in this. Columbia wax has a distinct taste which makes it undesirable.

The apparatus is worn continuously for a week to ten days only being removed to rinse out the mouth with an antiseptic lotion. If worn intermittently it should be worn for a much longer period than this.

In some cases a horseshoe-shaped apparatus can be fashioned one part going inside the mouth and the other part on the outer side of the cheek. Radium can be fixed to both aspects and the ulcer is thus attacked from both sides. I have seen many excellent results follow this method.

Dosage

In dealing with the cheek it is wise to under rather than over-estimate the dose. a second dose can always be given while injury to the thickness of the cheek must be avoided at all costs. I have never seen injury done to the cheek but the possibility is always in my mind when treating such a case. As a rule 800 to 1200 milligramme hours are sufficient with needles.

With surface radiation the dose can be 1500 to 2000 milligramme hours as the patient will not receive the whole dose

In extensive cases where the mouth cannot be opened and where the process has already spread to the jaws needling should be tried first then surface radiation from the mucous surface combined with surface radiation from the outside of the cheek. In this last great care must be taken as the skin of the cheek must be traversed by rays and therefore large doses must be used to produce any effect.

The most difficult cases to treat are those where the carcinoma is situated far back and has already spread to the ascending ramus of the lower jaw. In such cases there may be great difficulty in opening the mouth to get a satisfactory view except under an anaesthetic. If the ramus of the jaw is widely covered by the ulcer I have thrust in 44 millimetre needles containing 2 milligrammes of radium between the mucous membrane and the jaw from the skin surface behind the ascending ramus just below the ear and guided them into place with a finger in the mouth.

Mr C aged 50 seen in private 11th December 1928 with a growth on the left cheek.

History For twelve months he had noted a nodule far back on the inner side of the left cheek. It only worried him on eating and he had paid little attention to it.

On examination He could only open his mouth a little way. There was an ulcer on the cheek just touched by his two last molar teeth. It extended back on to the ascending ramus of the jaw. There were hard glands below the angle of the jaw. A piece was removed and proved to be a squamous celled carcinoma and the teeth extracted.

Four 27 millimetre 2 milligramme needles were inserted under the ulcer from the anterior border. Three 44 millimetre 2 milligramme needles were inserted under the ulcer from behind the ascending ramus of the jaw in the neighbourhood of the glands. It was difficult to insert them accurately. They were left in for six days making 2016 milligramme hours. In two months the ulcer had almost disappeared, the glands were no longer palpable. He did not come back again till 28th May when he said that he had great pain up the side of his face which kept him awake at night. He could only open his mouth sufficiently to eat. The ulcer had recurred and had infiltrated his masseter and internal pterygoid muscles and the ramus of the jaw.



FIG 31 —CARCINOMA OF THE INNER SURFACE OF THE CHEEK
AND INNER SIDE OF THE RAMUS OF THE JAW

X ray showing needles in position

Fourteen needles were inserted into the cheek either internally or externally and he was given a dose of 6860 milligramme hours

Very little effect was produced by this his jaw became more and more fixed his muscles and the bone of the lower jaw more and more infiltrated. He gradually lost weight and died towards the end of August

In this case it seemed that the initial dose was not sufficient to sterilise all the cells and that as a consequence they became very resistant to radium so that a dose more than three times the size given five months later had little or no effect

I am becoming more and more convinced that the first dose should be as massive as the tissues can stand and distributed in as many foci as possible

CHAPTER VII

NASOPHARYNX

GROWTHS in the nasal portion of the nasopharynx are usually of the same epidermoid epitheliomatous type as those of the mouth though sometimes the sarcomatous type are met with in the pharynx itself. Fortunately these last are even more sensitive to radium than the epitheloid type.

Growths of the upper jaw usually start in the wall of one of the air cells of the neighbourhood the *antrum of Highmore* being a favourite site.

Treatment by needles and tubes

If a fleshy mass is growing into the nasal cavity of the pharynx needles may be inserted into it. Often however the bone is expanded and there are plates of bone present needles then are not convenient and a passage must be made and a tube of radium inserted. After the needles or tube are in place the nostril may be lightly plugged to prevent them from falling out. Plugging in these cases is not the discomfort it usually is as the nostril is probably blocked already.

The tubes or needles should be mounted with wire which is fastened to the cheek with strapping and serves to keep them in place. Silk is better if the needles are inserted into the nasopharynx through the mouth.

Dosage

Little really can be said about dosage. It all depends upon the tumour its type and extent. It should not be overdone bone is in the near neighbourhood and cannot be shielded and is therefore liable to necrose. A larger dose will be required for carcinoma than for the same sized sarcoma.

A dose of 1500 to 3000 milligramme hours can be considered a very safe dose

A nephew seven years old whose father was serving in China was sent to see me as he was not making progress at school and was thought to be suffering from adenoids. On examination it was evident that he had a large growth in the pharynx. I had a piece removed and examined by Dr now Sir Bernard Spilsbury. It proved to be sarcoma. I took him up and down Harley Street showing him to throat and nose specialists none of whom would give me any encouragement for any form of treatment all saying that the condition was hopeless.

During this time the tumour grew out of his nose in front and down into the pharynx behind. It spread up through the base of his skull and parted the sutures of his head splitting his head and giving him the ghastly appearance of a cow with the eyes looking from the corners of his head. He became blind in one eye from pressure on the optic chiasma. At last Mr Cecil Graham suggested obtaining some radium and trying it. With difficulty we got it (this was in 1913) and put it into the tumour through the nose. The result was that growth stopped. We waited some three weeks and then reinserted it the bleeding was so severe that the child nearly died. After this his recovery was rapid and uninterrupted and deformity disappeared. Ten years later he won the boxing championship of his school and is now married and farming in Rhodesia some sixteen years after the insertion of the radium. He is still blind in one eye which is the only disability left.

In another case of mine which was seen too late the disease had passed from the antrum into the sphenomaxillary fossa and here it is almost impossible to reach its limits by any means in our power.

The following illustrates this well

Mde A. O. a Russian lady seen 12th June 1926 with swelling of the left side of her face. This had been coming on for a long time but she had taken no notice of it. On examination a growth was found in her left antrum of Highmore.

16th June 1926 The left upper jaw was removed and the growth was found springing from the posterior wall of the antrum, which it had destroyed and spread into the sphenomaxillary fossa. The deeper parts of the wound were plugged with gauze dipped in zinc chloride 40 grains to the ounce. During her convalescence she was given a course of colossal lead iodide

14th July 1926 She was given 2304 milligramme hours of radium by means of needles into her antrum.

11th December 1926 She had 3360 milligramme hours of radium placed round the site of the old wound

She was now quite well without a sign of malignant disease and insisted on having her appearance improved by filling up the hollow in her cheek threatening suicide if this was any longer denied her

24th February 1927 The cheek was filled out with fat from her buttock and her appearance greatly improved. She remained quite well till about May when she began to get very thin and a gland appeared in her neck but of this she took no notice In June she was readmitted and had radium applied to the cervical glands and to her sphenomaxillary fossa which was fuller than when she was seen last

She continued to lose flesh and showed a rise of 2 degrees of temperature each evening for which no cause could be assigned. She had nothing in her chest we could find and X ray showed nothing but she went steadily downhill. She died on 27th August.

I have another case sent me by Dr Wilfred Harris as a tumour of the antrum I asked Mr Graham to see him and he thought it was a tumour chiefly of the palate as the palate bulged Under an anaesthetic when his jaw could be opened the tumour was found to be in his sphenomaxillary fossa Needles 44 millimetres long were inserted into this recess through the temporal fossa through the coronoid notch and just in front of the coronoid process of the lower jaw The patient is now in Mount Vernon Cancer Hospital under observation If I have to insert more needles into him I think the best thing to do will be to resect the coronoid process and place enough needles into the fossa to deal with any growth that may still be there

CHAPTER VIII

TONSILS

Most new growths of the tonsils are of the squamous or the epidermoid epitheliomatous type and therefore react well to radium others it must be confessed are not so tractable and it may be that these are more adenomatous in type

A growth of the tonsil is often more extensive than it appears as the lower part of the tonsil cannot be brought into view without a mirror and reflected light The extent of the growth should always be carefully ascertained. The growth rapidly spreads from the tonsil on to the palate It may spread to the pharynx below the visible level

Seeds

The growths are eminently suitable for treatment by seeds if these can be obtained and there is an advantage in combining the seeds with the use of needles The difficulty of estimating the dose in the case of seeds should be borne in mind The seeds can either be mounted on silk and withdrawn after a time or just left to remain in or work their way out.

Needles

The length of the needle depends on whether the growth is high up or low down local or extensive In a growth high up needles of not less than 15 millimetres are used pushed in through the anterior pillar of the fauces and lying just outside the tonsil If the growth is extensive or spreads low down longer needles can be pushed downwards and backwards through the anterior pillar a finger in the pharynx is a great help in guiding them I prefer needles 27 millimetres in length Other needles may be thrust downwards through the posterior pillar If the growth has spread to the palate one or more needles of suitable length will be

needed between the layers of the palate. The dose in each needle may vary from $\frac{1}{2}$ to 2 milligrammes but 1 to $1\frac{1}{2}$ milligrammes will be found the most useful.

It is quite easy to insert needles close to the base of the tonsils from the outside of the neck. Needles of 44 millimetres are used containing 2 milligrammes of radium. With one finger in the pharynx as a guide the needle can be placed in position with accuracy. I have placed needles in this position instead of in the tonsil itself and have watched

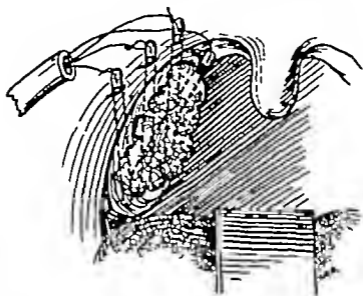


FIG. 32 — INSERTION OF NEEDLES FOR GROWTHS OF THE TONSIL.
Threads are entering rubber tube.

the whitish wash leather like appearance spread over the tonsil and pass on to the palate as far as the uvula before I have removed them.

To avoid wounding the large vessels I use bullet or round-pointed needles specially for such situations.

The needles should be left in position a week.

Surface radiation

In some institutions especially abroad surface radiation is given direct to the tonsil. The patient is put under the influence of narcotics so as to prevent retching and a heavy

dose of radium is pressed upon the surface of the tonsil for 3 to 5 hours at a time. The patient finds this is irksome and objectionable.

Surface radiation from the outside requires the removal of the angle of the lower jaw as is recommended in block dissection to remove the glands lying deep to the lower part of the parotid. It is best carried out subperiosteally with the electric circular saw the bone being too dense to be dealt with easily by other instruments.

A plaque of Columbia paste is made in the ordinary way and radium applied to the outer side for two weeks. This method is recommended by Stanford Cade. My own experience shows that the tonsil is so accessible to needles from the inside and so influenced by needles inserted from the outside that removing the angle of the jaw is uncalled for especially when it is remembered that the radium must act in the most wasteful manner through the whole thickness of the neck. There is another drawback to the proceeding and that is that if a block dissection of the neck has to be done later scar tissue and the previous disturbance of parts is the last thing to be desired. I do not think that this method has anything to recommend it.

F B S aged 58 came home from South Africa suffering from carcinoma of the tonsil, of an extremely active nature many mitotic figures being seen in the slide. For four months he had been treated for syphilis.

The upper part of the tonsil was replaced by a prominent hard mass spreading on to the palate as far as the uvula which was thickened and deformed.

Three needles of 27.7 millimetres containing 2 milligrammes of radium were put through the anterior pillar of the fauces in a downward and backward direction. A fourth was thrust upwards and outwards into the palate from near the uvula all were stitched in position. Two needles of 44.4 millimetres containing 2 milligrammes of radium were thrust across the base of the tonsil from the outside these were removed in 4 days. The needles from the tonsils were removed upon the fifth and sixth days in all he received 1874 milligramme hours. The glands in the neck began to swell and give rise to anxiety. A week later the glands in the



FIG 33



FIG 34



FIG 35

F B S BEFORE, DURING AND TWO MONTHS AFTER TREATMENT

neck were exposed and two 44.4 millimetre needles and three 27.7 millimetre needles each containing 2 milligrammes of radium and four bullet pointed needles of 27.7 millimetres containing 1 milligramme of radium, were inserted into the glands one 44.4 millimetre needle of 2 milligrammes was placed across the base of the tonsil again in close proximity to a gland. The whitish appearance which by now had faded from the tonsil gradually came back and spread to the palate in eight days it had reached the uvula and the needles were removed. A dose of 2972 milligramme hours ($16 \times 8 \times 24$)

Two months later he was free from all sign of disease and later returned to South Africa and when last heard of was well. (See Figs. 33 34 35)

Glands in the neck

There is the same difficulty in dealing with metastases in the glands in carcinoma of the tonsil as there is in carcinoma of the tongue. The treatment both with needles and with surface radiation has been fully detailed when dealing with the tongue

CHAPTER IX

BREAST

THE mastery of cancer anywhere rests with our ability to come to an early diagnosis and apply the appropriate treatment nowhere is this more true than in carcinoma of the breast

During the last generation the operation for the removal of the breast increased in magnitude about three fold but our results are not three times as good as they were with smaller operations During the same time diagnosis was becoming better and people were being educated to come earlier and many surgeons now recognise that the benefits we have reaped during the period of the increased operation were not altogether due to its increase in size but that earlier diagnosis was probably the predominant factor

In the early stages carcinoma is a local disease later it is situated in the breast and in the glands of the axilla it may still be altogether extra thoracic later still it is intra as well as extra thoracic and has probably found its way by embolism along the lymphatics into the abdominal cavity as well Let the surgeon plan his so-called radical operation as he will he can only deal with the extra thoracic portion of the disease the patient's life will not be prolonged she will die of the internal metastases the seeds of which have already been sown

That is the position at the present day Can radium benefit this patient? The answer is emphatically Yes! It can do it in several ways. Let us see how

First there are a certain number of people about the age of 40 to 50 who find a lump in their breast and through ignorance they ignore it till the evil has spread This class

of case can still be found in the hospital out patient department but for every one such person that I see at hospital I see six in my consulting room who have found such a lump and have avoided their doctor through fear of being told it is cancer and having to undergo an operation. It is not fear of cancer that possesses them it is fear of operation and disfigurement which they know accompanies all cancer operations.

They will undergo any form of treatment that a knowing friend will suggest they will attend any unorthodox practitioner who will treat them and carry out the most absurd instructions as to exercise diet and habits so long as no operation is suggested. These people know or fear the lump is cancer and hide the fact from themselves so as to avoid the disfiguring operation. Now if early diagnosis had the importance I believe it has and we can impress upon the public that if when such a lump is found they will go at once to their practitioner and get cured by radium and so avoid an operation we shall have done more for the treatment of cancer than has been done in the last fifty years.

This I think is one of the greatest indirect benefits radium will contribute to the treatment of cancer anywhere in the body.

Secondly we all know the case where there is a slow growing mass in the breast for which a radical operation is performed and shortly afterwards we find small recurrences spreading over the chest wall for which little can be done by ordinary surgical means and the patient dies in a comparatively short time.

Now if that growth had been left alone its progress would have continued but such a wide infection of the tissues would not have taken place. We do not see this rapid infection of the tissues without operation. The cells do not grow readily in the lymphatics till the last stages of the disease we must therefore attribute this development to the operation which has cut across the infected lymphatics and allowed the cells to escape and grow broadcast through the tissues.

Radium can control this spread of the disease in a way nothing else can but the use of radium in the first place will prevent its occurrence.

Thirdly nowhere else in the body have the advocates of radical operation had such a free hand as in carcinoma of the breast and to do them credit they have carried it to its logical conclusion. At one time the removal of the growth a wide area of tissue round and the whole of the lymphatic field including the glands above the clavicle was advocated. This last procedure has been abandoned as unnecessary. We now recognise that radical operation can only deal with the extra thoracic portions of the disease. By means of radium however we can follow the lymphatics some way into the chest at the anterior ends of the intercostal spaces. I notice that some place radium above the clavicle but if there is no necessity to remove these glands then there is little necessity to treat them with radium. I also notice that many recommend the placing of needles along the lymphatics in the intercostal spaces this again I do not consider necessary as no growth is seen there. I much prefer to thrust the needles into the chest at the anterior ends of the intercostal spaces so that they lie in the region where the glands are situated. Anyone whose radium is limited should bear this in mind.

The microscopical confirmation of the diagnosis

Unfortunately if a mass in the breast is treated with radium it does not matter how pronounced its characters may have been if it disappears it is very difficult to convince a hearer that it was a carcinoma. For this reason many surgeons have cut into the growth removed a piece for examination and then treated the patient with radium. There can be no doubt that this is a bad procedure. In the first place incomplete operations on carcinomata allow the escape of the malignant cells into the tissues with results which are too well known to need emphasis. This risk can to some extent be minimised by cauterising the cut surfaces

but it is difficult to imagine a surgeon allowing such a procedure in the case of a relation and what we would not recommend to our relations cannot well be recommended to others. Dr Heyman of Stockholm also makes the statement that at the time when frequent bioscopic examinations were made from growths of the uterus where little tissue could be opened up the results were not so good. The procedure may be defended from the scientific point of view but from the patient's standpoint there is nothing to recommend it. It is possible first to treat the patient with radium and after disappearance of the growth to excise the place. But even this is not quite free from risk as some cells may be in a dormant condition and again awakened into activity. The patients on the other hand may object for the majority of private cases have chosen radium as a means of avoiding an operation. They care nothing for scientific proof or scientific investigation.

The method I have adopted though faulty avoids some of these difficulties. The operation the patient objects to is the disfiguration entailed by the removal of her breast and operation in the axilla is not objected to in most cases. If glands can be felt I clear out the axilla completely while treating the original growth with radium. To do this properly it is necessary to divide the pectoral muscles close to their insertion thus being the only part where they are tendinous. The pectoralis minor I sew to the under surface of the major at the end of the operation.

If glands are infected we have proof of the nature of the mass in the breast if not they may show changes which Dr Newcomb tells me accompany carcinoma of the breast. If the glands after removal are found to be infected needles are laid along the vessels and pushed well up under the clavicle into the root of the neck and are left in place for three days.

Naturally in early cases no glands can be felt and probably excision would not reveal anything either. They can be left alone and watched for if they are infected they will very soon declare themselves and can then be dealt with.

P M aged 35 admitted to St Mary's Hospital 17th November 1927 for carcinoma of the left breast

History Noticed a lump in the breast in 1905 and was under treatment for it by her doctor. In August 1926 the lump began to grow and she began to have pain and she noticed two small lumps in the axilla.

On examination the left breast was smaller and less pendulous than the right the nipple on a higher level and retracted. The skin was bound down and dimpled readily over a lump in the upper and outer quadrant measuring 3×2 inches which was free from the muscles. Two glands were easily felt in the axilla, and there was an indefinite thickening passing from the mass to the axilla.

The axillary glands were removed and some from the very apex were found infected. Two tubes of radium containing 50 and 45 milligrammes were inserted under the mass no needles were available or they would have been inserted under the tumour for its whole length as well as all round it.

Pathological Report Secondary polygonal celled carcinoma in the lymph glands

The skin is still puckered where it was drawn down to the old growth by the shortening of Cooper's ligaments but all that remains of the tumour is a slight thickening.

She reports herself regularly

Another method I have used frequently in really early cases where not a single malignant sign has yet developed is to remove the growth locally with a fairly wide margin of tissue examine it with the naked eye which in the majority of cases will tell all we want or have a frozen section examined and if it proves to be malignant treat for carcinoma with radium needles. This method lacks the proof that the cure is brought about by radium as I have many five-year cases in which local operation alone has proved quite sufficient.

TREATMENT OF CARCINOMA OF THE BREAST

The treatment of carcinoma of the breast may be divided up into the treatment of the primary growth the inoperable cases and the metastases

Primary carcinoma of the breast

Here the growth may be small and of an early or doubtful nature or it may be large with pronounced malignant characteristics such as adherence of the skin retraction of the nipple and hard glands in the axilla

Needles

In dealing with carcinoma of the breast needles should be long enough to pass in under the growth. In stout people with large breasts longer needles are needed than in thin people with small breasts. In stout people who have a considerable layer of fat needles of 27·7 millimetres may be used but must be inserted by means of a trocar and canula when they can be buried completely below the skin and fatty covering of the breast. Needles of 44 millimetres are better and better still are 60 millimetres. The better to deal with such cases I have ordered my last needles of 65 millimetres in length containing 3 milligrammes of radium so arranged that there are 10 millimetres near the eye which contain no radium see Fig 10

The needles are thrust in near the periphery of the mass and made to converge under the centre. Two or even three concentric rings of needles may be used in large masses. Where there is no chance of the needles reaching the centre shorter needles are thrust from the surface vertically into the growth. The rings of needles are arranged on the same piece of wire after the manner of a tiara as shown in Fig 36. If the mass is small and can be readily approached the needles can be thrust in under it lying parallel to one another. Concentric rings of other needles can be arranged around the tumour margin. A piece of gauze is laid upon the breast and the ends of the wire twisted up over it and the whole fastened firmly on with broad strapping which takes a good hold on the chest on each side of the breast. Wool is then laid on and a broad bandage fixes all in place.

If the axilla has not been operated upon long needles may be placed in it. Needles can also be placed parallel to and

just below the clavicle along the costa-coracoid membrane. Needles can if thought desirable be placed above the clavicle, but thus I do not think is really necessary. If removal of these supra-clavicular glands has been abandoned in surgical practice it is because they are seldom infected and if so they need not be treated with radium. More important is it to thrust needles of 27 millimetres into the anterior medias-

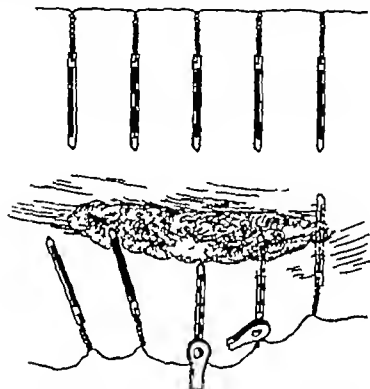


FIG. 36.

Needles arranged in a tier of five on wire which is an exceedingly handy way of using them and makes it easy to remember the numbers and sizes of the needles used. If wire is used the number of sharp ends of wire is minimised.

tinum just where the anterior branches of the intercostal vessels leave and enter the chest blunt or bullet-pointed needles can be used. Here glands are present the state of which cannot be ascertained.

One or two long needles may be placed along the lower edge of the pectoralis major along the lymphatics which pass along the pectoral vessels and also along the subscapular

vessels to the axilla. Twelve needles may suffice for a small mass while thirty may be needed for a large one apart from the needles in the region of the glands. The needles are left in for about a week. large growths in bulky breasts should be

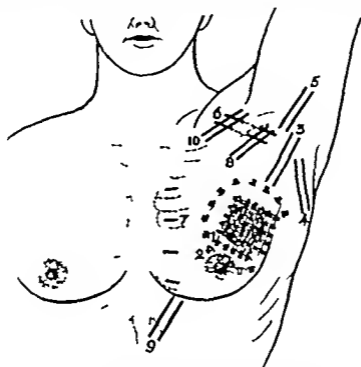


FIG. 37.—AUTHOR'S METHOD OF PLACING NEEDLES.

- 1 Needles placed under the growth, sometimes one sometimes two layers in grid iron form.
- 2 Needles placed round the growth, sometimes one sometimes two circles (not shown at the side).
- 3 Needles along the lymphatics at the lower margin of pectoralis minor.
- 4 Along the subcapular lymphatics.
- 5 Along lymphatics of axilla.
- 6 Position of needles up under clavicle if the axilla is cleared of lymphatics.
- 7 Along lymphatics accompanying the internal mammary vessels.
- 8 In position of costa-coracoid lymphatics.
- 9 Towards the dangerous angle.
- 10 Above the clavicle.

It is not necessary to insert all these needles every time

given a longer period than small growths in less ample breasts as the needles in the former are further from the skin. In large growths I use a tube of 25 or 30 milligrammes sometimes both enclosed in a sharp-pointed container and thrust

deeply under the growth so as nearly to reach the other side. Marks are made upon the wire at inch intervals and each day the wire is drawn out one inch so that the radium thus acts upon a large area of malignant tissue.

The whole area should be suffused with a red blush on the tenth day and later some of the skin may peel superficially. On removal of the needles necrotic tissue can be squeezed from many of the needle holes and with ordinary radium needles where the radium is near the eye and which have not been completely buried some of the skin will become necrotic for two or three millimetres around. A hot boracic fomentation can be applied and is very comforting. At the end of twenty four hours an ointment of white vaseline to which is added 5 per cent eucalyptus oil can be used spread upon gauze.

Diminution in the size of the mass can be noted in ten days to a fortnight after removal of the needles. It becomes softer and less defined and a mass between half a tangerine and half a walnut will have quite disappeared by the end of two months. If the mass has been attached to the skin evidence of adherence can be seen by the shortened ligaments long after the growth has disappeared.

Fig 38 shows the method followed by Mr Keynes at St Bartholomew's Hospital. It shows the distribution of twenty five 60 millimetre needles in the region of the growth and ten 27·7 millimetre needles in the axilla and below the clavicle. Considering the cases at his disposal the results have been encouraging.

Fig 39 shows the method recommended by Mr Stanford Cade who combines this method with application of Columbia paste cuirasse for fourteen days and the use of 100 milligrammes of radium.

From this the reader will see that there is no one stereotyped method of treatment nor do we know as yet which will give the best results time alone will show.

Mrs. D. aged 51 seen in January 1926 with carcinoma of the right breast. She had known of a lump for about six months

The lump was in the upper outer quadrant of the breast the nipple slightly fixed. The skin was dimpled slightly.

There were small hard glands in the axilla.

The axilla was cleared out and needles inserted under and round the mass in the breast into the chest at the anterior ends of the intercostal spaces and into the axilla along the vessels passing under the clavicle and along the subscapular vessels. The needles were left in the breast seven days, in the intercostal spaces four

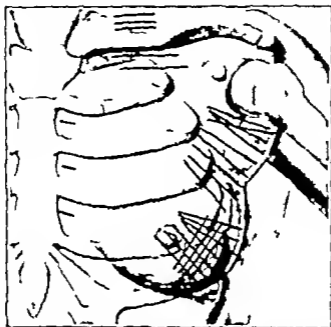


FIG. 38.—DIAGRAM SHOWING TYPICAL DISTRIBUTION OF RADIUM NEEDLES

As used by Mr. Heynes at St. Bartholomew's Hospital.
(*The Lancet*, 1918 vol. ii, p. 29.)

days and in the axilla three days making a dose of 6720 milli gramme hours for the breast 504 for the axilla and 188 for the intercostal spaces.

Pathological Report Polygonal celled carcinoma.

Two months later there was only a slight thickening left and this with time has grown smaller. There has been no further trouble. This is typical of a successful case and is illustrative of what can be done.

Another case which was only partially successful is the following but as it was not suitable for operation even when first seen the result can hardly be called unsatisfactory.



71—CONTENT OF DISTRIBUTION OF NEEDLES IN THE BREAST

According to Mr. Stanford Cade
Radium Journal (after J. & A. Churchill)

- (1) In the tumour
- (2) Around the tumour
- (3) In the parasternal area
- (4) Along the costa-coriacoid membrane
- (5) In the supra-clavicular area
- (6) In the axilla
- (7) In the mid-axillary line

Mrs X was sent to me from Broadmoor Institution in January 1927. She was a case of acute carcinoma with a breast hard prominent fixed enlarged and full of growth covered with brawny pigskin. I wrote to the Home Secretary to say that in my opinion she would not return to the institution. Needles long enough to under-run the growth were not obtainable so that two concentric rings of needles the inner one 27 millimetres and the outer 44



FIG 40.—COLUMBI PASTE CUIRASSE APPLIED TO CHEST
SHOWING NEEDLES IN POSITION SUNK IN THE WAX. THE
LEAD COVERING IS THROWN OVER THE SHOULDER.

millimetres were used all containing 2 milligrammes of radium. They were left in for a week making a dose of 4200 milligramme hours. Her reaction was good improvement began at once and she was sent to Mount Vernon Hospital. In two months time the same number and sizes of needles were inserted again. In another two months there was little to choose between the two breasts and she was so well she had to return to the institution.

In January 1928 the doctor wrote

Her condition appears to remain stationary—sometimes I think there has been a slight improvement. Her physical condition has certainly been maintained and she was at her last weighing thirteen pounds up compared with her body weight four or five months back. She complains of pain at times but this is not constant. Eighteen months later I went to see her only to find that the growth had recurred locally and in the other breast and that she was now sinking.

Surface radiation

As a rule after the reaction created by the application of needles has passed off I wait one to three months and then apply radium over a wide area on Columbia paste. A mould is made covering the affected breast and reaching from the middle line in front well round into the axilla and up above the clavicle if there is any need to apply radium to this region. The area of the growth is mapped out upon the paste with a pin. The radium is distributed where it is desired more thickly over the growth towards the axilla and over the lymphatic areas than elsewhere. Care should be taken to see that the radium is distributed so as to penetrate the whole breast to make sure that scattered cells do not escape. In pendulous breasts the mould should pass down under and up behind the breast. The skin under the breast must be protected from the radium with lead. The needles can be fixed to the mould with strapping and the whole covered with a thin sheet of lead also fastened to the paste with strapping. The paste should be worn for at least ten days. Considerable reaction will ensue depending upon the dose of radium applied. In severe reactions the skin will be shed and there is a considerable amount of irritation. It is best to apply a soft ointment on lint and keep the part covered. Zinc oxide and lanoline to which enough almond or other oil is added to make it very soft. Lanoline gives a cool feeling and is better than the warm sensation of the paraffins. The patient should be warned of this reaction beforehand as I have known them go home and the reaction come on later and their doctor not being quite sure of his

ground has not been able to reassure them sufficiently and they have been very much upset mentally in consequence

Mrs T seen January 1928 for inoperable cancer of the right breast

History About two years ago noticed a small nodule in her breast which her doctor said was nothing she took no further notice of it though it had steadily grown No symptoms

On examination there was a prominent mass in the upper and outer quadrant of the right breast attached to the skin over an area of 4×3 inches. There was a mass of glands in the axilla and palpable glands above the clavicle The other breast and other glandular areas appeared normal.

6th January needles ranging from 27 44 and 60 millimetres in length and 2 to 3 milligrammes in strength were inserted into the breast the axilla, intercostal spaces and above the clavicle giving to the breast 7393½ milligramme hours to the axilla 1344 milligramme hours and 240 to the glands above the clavicle. A 30 milligramme tube was moved about daily below the tumour giving a dose of 1440 milligramme hours.

Three weeks later the skin was red dusky and peeling in places Five weeks later the surface was still weeping in two places the lump was softer more or less defined, the glands in the axilla and above the clavicle could just be felt. In another month the mass was $1 \times 1\frac{1}{2}$ inches the skin had healed and the glands still just palpable. Four months after the needles were applied a Columbia paste cuirasse was fitted and 12 884 milligramme hours applied to the area of the chest causing a fierce reaction which did not pass off completely for three months Since then the breast has shrunk down but there is a hard mass to be felt the glands above the clavicle and those in the axilla are barely palpable

How long she will remain in this state one does not know but I believe that activity will again show itself

Inoperable cases

These are cases where either the disease has gone too far and the mass is adherent to the chest wall or where fungating surfaces exist or where metastases in glands are too wide spread to give any hope of removing the disease

In such cases it is almost certain that the internal organs are already infected and the patient's life will not be prolonged by merely removing the extra thoracic portion of the disease

Our task here resolves itself into healing any ulcers or fungating surfaces and thereby rendering life more supportable and decreasing the size of any known tumour which will have a great beneficial mental effect upon the patient. These two objects we can guarantee though little more can be hoped for.

Treatment

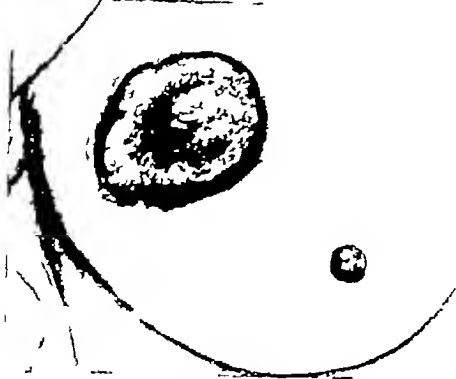
This is conducted on the same general lines already laid down but larger doses can be used and a larger number of tubes can be inserted under the mass. Redness and peeling of the skin should be sought without actual destruction of the superficial healthy tissues. After an interval of two to four months another course can be given.

The tubes can be removed in three to four days and the needles left in for eight to ten days giving a dose of ten to fifteen thousand milligramme hours.

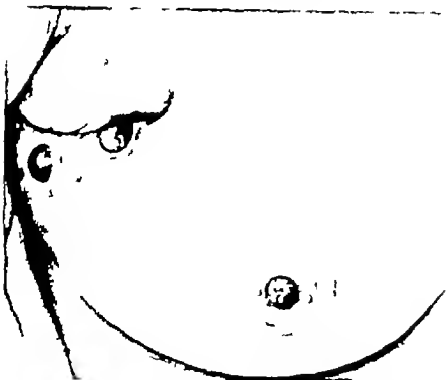
The primary growth even when of large size can be made to disappear in others it will become smaller more mobile and less defined. It is said that inoperable cases may become operable but this I doubt as life would not be prolonged because of the internal metastases which in the majority of cases must by then be forming. Only one case in my experience could have been operated upon and in this case the growth so completely disappeared that there was little to be gained by operation.

Fungating or large ulcerated areas

In dealing with large fungating areas long needles should be inserted round the edge and shorter needles into the centre of the mass. Tubes containing 10 20 or 30 milligrammes can be buried in the growth if it is large and prominent. If there is much discharge daily dressings will be necessary gauze soaked in liquid paraffin and flavine is very useful as it does not adhere. The needles in the softened sloughing centre are very likely to come out when changing the dressing but this does not matter as they can



Mrs. H before radiation 15th March 1929



Mrs. H after radiation 4th June 1929

I begged her to have another treatment but she never consented to it

(See p. 87)

be reinserted again in a different place without an anaesthetic so that their action can be distributed all over the growth. The tubes can also be moved and can be left in nearly as long as the needles.

Even large prominent masses can be made to disappear or become insignificant ulcers. The worse the condition is to begin with the greater the effect which is produced. Ultimate cure in such cases is not to be looked for. Very large doses can be given in such cases.

Mrs B. aged 64 a patient of Dr Frankish seen 25th January 1929.

History Last June noticed a swelling in right breast which burst and discharged and never healed. This she concealed from her doctor till it gave pain a short time ago.

Present Condition A pale cachectic woman. A fungating prominent mass 6 x 8 inches occupied the whole of the right breast discharging fluid and pus copiously.

The glands in the axilla and above the clavicle were enlarged. Liver enlarged probably from metastases.

28th January 1929. Needles and tubes were inserted into and around the mass and a dose of 8976 milligramme hours was given. Great improvement took place the fungating mass flattened out and became cleaner and shrank in size. She was a better colour and healthier in every way.

26th March 1929. Another dose of about the same size was given.

15th May 1929. The ulcerated area had shrunk down the discharge was practically stopped and she had gained 1½ stone. The glands of the axilla and above the clavicle were smaller due probably to the lessened sepsis.

Her liver however was larger.

Two months later she began to go down bill owing to internal metastases.

Mrs H. aged 50 sent by Dr Harvey 5th March 1929. See Coloured Plate.

History Last September noted a hard lump in right breast but had no pain. She fomented the lump and this broke at Christmas and has got rapidly larger. Now has pain.

She was an extraordinarily sensitive nervous woman who hardly at any time would let me look at the breast till coaxed for 15 to 20 minutes even while being treated.

On examination. The whole upper and outer quadrant of the right breast was a stinking area covered by a dark green slough.



FIG 41—CARCINOMATOUS ULCER REPLACING THE BREAST BEFORE TREATMENT



FIG 42—SAME CASE AS ABOVE—larger scale—two months later

2½ inches in diameter surrounded by a red rolled-over wall, raised ¼ to ¾ of an inch above the surface and ½ an inch thick.

She refused all treatment for a fortnight and then had a dose of 8024 spread over 5 days more she would not consent to. Unknown to her the needles were moved about and thrust into new areas during the dressings.

20th May 1929 The ulcer was nearly healed, but her axillary glands were enlarging but for these she would accept no treatment.



FIG. 43.

The following case points its own moral.

Margaret K. aged 50 was admitted in March 1929 to St Mary's Hospital, with inoperable carcinoma of the breast. She had known of the mass for over a year but had not approached a doctor till last week. She had a fungating area 4 x 5 inches to the outer side of her left nipple the breast had almost disappeared. There was an indurated gland in the axilla. Needles of 27 37 44 and 60 millimetres were inserted into under and around the ulcer. She was a thin woman and in slipping one of the longer needles under the ulcer I think I penetrated the intercostal muscle deeply and entered the pleural cavity. As a result she developed

a very high temperature and an empyema was opened and very foul pus was discharged

The needles had at once to be withdrawn or she would have been given a larger dose than the 6246 milligramme hours which she received. Later during the following three weeks while treated for her empyema, a surface application of 10 milligrammes was moved about over her ulcer and she received about 2505 extra milligramme hours

She was later sent to Mount Vernon Cancer Hospital where she is still running a temperature and discharging pus from her empyema wound though her ulcerated area is very nearly healed

Metastases

We know that certain tissues are favourable to the growth of metastases while others seldom allow their development. The subcutaneous tissue liver pleura and peritoneum readily allow them to grow but we seldom see them in the muscles or the bones below the elbow or the knees. There are of course exceptions to this rule. We are here dealing with external metastases to which radium can be applied

Metastases can be divided into three clinical groups the solitary metastases those which occur in large numbers and spontaneous fractures of bones due to solitary metastases in the long bones which occur many months or even years after the original operation

Solitary metastases

The name solitary metastases is not quite accurate but as a rule they are few in number three or five at most and it serves to distinguish them from the next class which are quite different. They may be situated far apart and may have reached a large size before the patient comes for treatment. They are probably cells borne by the blood stream which have settled in suitable tissues

Treatment

Each one should be treated exactly in the same way as if it were a primary growth. Needles of the appropriate length are thrust in either parallel to one another or in a radiating manner at the periphery. They are left in for

about seven days and then removed. In the course of a few weeks the whole metastasis will disappear. It is not a good sign when such metastases are found for it means that carcinomatous cells have been sewn broadcast throughout the system and that very possibly some have lodged in the internal organs or in the bones.

Mrs H. aged 57 was admitted into St. Mary's Hospital nine years ago and her right breast was removed for carcinoma. She remained perfectly well till some four years ago when three lumps appeared at the same time. One was to the inner side of the scar the other near the right shoulder and the third near the spine. These were all superficial and were about the size of an unshelled walnut cut in half. Radium needles were inserted in a radiating manner round and under each of these metastases which were given doses of about 1440 milligrammes each. At the present time some four years later there are the leucoplakic marks left in front and a brown pigmented spot behind to mark the site of the metastases. Since then she has shown no sign of metastases.

Multiple metastases

These are far more serious than is the solitary metastases. They always appear in the region of the scar. They are the direct result of and a serious drawback to the radical operation from the cutting across of the infected lymphatics and the escape into the tissues of the malignant cells. They have the faculty of spreading with great facility along the lymphatics of the subcutaneous tissues. The lymphatic drainage of the scar area is completely upset by the removal of all the glands from the axilla and therefore they will drain in all directions into the axilla of the opposite side and also into the groin of both sides and these multiple seed like nodules spread rapidly over the whole of the chest and abdomen and back towards the spine. As a result the affected area is sewn with nodules varying in size from a millet seed to a small bean.

Treatment

Treatment with the object of cure at the present moment is almost impossible. Control and delay in spread is about all we can hope for.

Needles

The best way of dealing with these multiple metastases is to surround the area in which they occur by needles containing $\frac{1}{2}$ 1 $1\frac{1}{2}$ or 2 milligrammes of radium so as to try and limit their spread at the same time needles of $\frac{1}{2}$ to 1 milligramme are inserted under the nodules which have already appeared. The surrounding needles can be left in for six days but the needles under the nodules can be removed at the end of three days and reinserted with a local anaesthetic under other nodules for three more days. In this way many nodules can be obliterated. My experience of these cases urges me to state that in spite of this treatment other nodules will appear after a time outside the ring formed by the surrounding needles. When this happens the process must again be repeated. It delays the spread but does not stop it. After a time evidence of internal metastases appears and the patient inevitably sinks.

The following case is an example where the superficial metastases could be controlled but could not be prevented.

Miss C. aged 63 a patient of Dr Rose of Barnet seen 4th October 1926

History Three years previously had burnt her breast with iodine for some reason unstated then she noticed the nipple disappearing and a year ago she said the nipple dropped off. Her sister had had a breast off for carcinoma and she was very frightened and refused to see her doctor. I only examined her with great difficulty.

She had a small right breast completely occupied by a hard cancerous mass and small glands in axilla.

5th October 1926 A radical flap operation performed and axillary vein removed. Recovery was uninterrupted.

Pathological Report Solid alveolar trabecular and rarely tubular polygonal celled scirrhous carcinoma invading the skin and axillary glands. The growth in the glands is more active than that in the breast and contains many mitotic figures.

Refused to see me again for a year but on 15th October 1927 was found to have the skin all round the scar sewn with small nodules situated in the superficial lymphatics.

Twenty five needles containing 2 milligrammes each were placed under the skin all round the area to shut it off and kept in for a

week. Needles were also placed under nodules and moved from one to another. The result was excellent the nodules all disappeared she then was advised to have X ray treatment and Dr Harrison Orton gave her three exposures at intervals of ten days and then three more at longer intervals.

1st February 1928. Other nodules have appeared outside the area ringed with radium. These extend right round the back. Twenty five more needles were applied and a 50 milligramme applicator applied on a block of paraffin to the larger nodules.

21st March 1928. At least 30 nodules disappeared completely under this treatment but other tiny nodules appeared elsewhere within a month.

In April she got a spontaneous fracture of the left thigh and signs of internal metastases began to appear.

In August we again made large numbers of nodules disappear with radium but it was only to please her.

In October her fracture which had joined again gave way. She now showed a most curious condition small areas supplied by cutaneous arteries would show triangular areas crowded with metastases just as if that one artery had had a malignant embolism break up and scatter its cells over its area of distribution. Several of these areas became visible on the forearm and legs.

Her liver enlarged and she died 20th November 1928.

This was one of those cases where undoubtedly the seeds of cancer were sewn broadcast through the tissues by the operation and as she was a very scirrhus case I am not at all sure that the operation did not hasten the end which it was desired to postpone.

Columbia parte

In this form of treatment a large amount of radium must be available for long periods and for this reason until comparatively lately I was unable to use it. It is impossible to follow this line of treatment in hospital practice where every surgeon and physician has a claim upon the limited amount of radium available for the hospital. One surgeon cannot take the whole amount available and devote it to the treatment of one case for a period of two to three weeks especially as it is the custom at St Mary's Hospital for the surgeons to hire out the radium to private cases. It is absolutely

necessary to have one's own private supply so as to be able to supplement the hospital radium. This has naturally restricted my experience in hospital practice my private radium being almost continually in use.

When the nodules first appear a Columbia paste mould is made of the front and side of the chest. It is customary but I find unnecessary to protect the clavicle and sternum with lead or lead rubber and the ribs must of course be ignored. I have never seen necrosis occur. The spleen and liver are similarly protected according to the side treated. Some 50, 60 to 70 or even more needles are needed depending on the area to be treated. They are sunk into the outer side of the paste or are fastened between two layers of plaster in strips so that they can be moved about.

The plaque is worn for a fortnight to three weeks so that if 70 milligrammes are applied for two weeks ($70 \times 14 \times 24$) a dose of 23,420 will be given. Some superficial desquamation will result and this will become worse for about fourteen days after removal. The irritation is best treated with white vaseline or lanoline to which 5 per cent eucalyptus oil is added. Improvement will then take place and everything should be healed in another month. The result is as a rule satisfactory and all nodules may disappear.

Mrs. A. aged 56 had had her breast removed for carcinoma 18 months previously. She had developed a widespread crop of small nodules varying in size from a pin point to a pea. They had started in the usual place about two inches from the scar where the lymphatics had been divided. These had spread over the front of the chest and round to the posterior axillary line.

A plaque was moulded to her chest and 75 milligrammes of radium was distributed over the surface. She wore this continually for ten days receiving 18,000 milligrammes ($75 \times 10 \times 24$). In two months every nodule had disappeared but three months later pin points began to develop outside the area radiated. By this time she developed symptoms of internal metastases which caused death in six months' time.

If sufficient radium is available it might be better to submit every case operated upon to this treatment especially

those late cases where it is suspected that the lymphatics are heavily infected. At present this is impracticable from lack of radium. Disappointments must even then be met with from the fact that internal metastases have already been disseminated before operation but at the moment we do not really know how deeply radium can strike at young malignant cells. In other words it is uncertain if internal metastases can be treated in this manner and at the present time we rely upon X rays with very poor results.

Soon it may be possible to treat by radium the secondary metastases of the liver, lungs and peritoneum.

Spontaneous fractures

Perhaps nothing is more disheartening than to meet with spontaneous fractures of the long bones years after an operation upon the breast. No form of carcinoma affects the long bones with the frequency that breast cancer does. It is unknown in carcinoma of the stomach and almost equally rare in cancer of the uterus. This proves what is not generally recognised, that certain forms of carcinoma will grow more readily in some tissue than will others.

As a rule spontaneous fracture in a long bone is a precursor of other complications. X ray photographs often reveal that other bones are widely invaded but only those fracture upon which strain and stress are thrown such as the femur and the humerus. When this is the case any treatment must be disappointing in its ultimate results. In some fractures however the local conditions will benefit by placing needles all round the fracture as close to the bone as is possible. This is best done by means of a trocar and canula. The patient should be taken to the X ray room and under the X rays the position of the bones can be made out. The trocar and canula can be made to place the needles in the position desired directly under the eye of the operator. The needles are left in for ten to fourteen days in the case of the thigh and seven to ten days in the case of the humerus. Union will more readily take place after this treatment.

Mrs D aged 61 sent me on 16th April 1926 for a lump in left breast which she had only noticed a month ago. This was becoming attached to the skin. Glands were felt in the axilla.

18th April, 1926. A radical flap operation performed.

Pathological Report Carcinoma.

January 1929 she sustained a spontaneous fracture of right thigh in the upper third. Twelve needles of different lengths were inserted and left round the region of the fracture and left in situ for 10 days making a dose of $(26 \times 24 \times 10)$ 5840 milligramme hours. See Fig. 44.

The thigh united.

X rays showed the pelvis and other bones extensively invaded.

The bone rapidly united.



FIGS 14 AND 15 NEPTIS ARRANGED ROUND SPONTANEOUS FRAGURES OF THE LIMUR

CHAPTER X

RECTUM

THE majority of malignant growths of the rectum are situated within 6 inches of the anus and only a few at a higher level. In most of them dissemination is late; it takes place most commonly along the lymphatics lying in the sigmoid flexure and by the blood stream the emboli are carried in the portal circulation to the liver.

Before committing oneself as to procedure the growth must be investigated with the finger in the rectum and with the short or long sigmoidoscope. In women vaginal examination is most useful.

A colostomy should always be performed. It gives the part rest, lessens the congestion, slows the rapidity of growth and materially eases the pain. If metastatic growths are found in the liver at the time a colostomy is performed the patient should be spared all operative procedures except those calculated to make him as comfortable as possible for the remainder of his days; for the most extensive radical operation will not prolong his life a single day—he will die of internal metastases.

The colostomy

The preliminary preparation differs in no way from that for the ordinary operation: the lower bowel should be thoroughly emptied. When the abdomen has been opened the hand in the abdominal cavity makes out the limits of the growth above the pelvic floor, the glands in the meso-sigmoid and the lumbar region and the condition of the liver. If no metastases are found in the liver and no enlarged glands are felt in the meso-sigmoid so much the better. If the glands

are felt in the meso-sigmoid needles should be inserted along side these glands and the wires brought out of the end of the wound by the side of the unopened bowel. The needles may be removed at the end of a week. Bullet pointed needles may also be slipped into a fine catheter the ends of which are afterwards tied. The catheter should be inserted behind the peritoneum and insinuated along so as to lie by the side of the lymphatics and glands. The end protrudes from the wound and is transfixed by a safety pin. It may be withdrawn in three to four days before the bowel is opened.

When the bowel is brought to the surface the growth in the rectum can be attacked.

It may be attacked at once or by a second operation later. Unless the patient is weak and the operator slow it is better to attack the growth at once as it is quite possible that a third anaesthetic may be called for to close the wound.

Growths low down in the rectum

Here a protoscope or short sigmoidoscope is used and needles are inserted near the lower edge of the lesion and passed so as to underrun the growth or ulcer. The needles should be long enough to traverse the whole width of the ulcer longer needles being used for the centre and shorter ones at the side. Longer needles may be thrust in through the skin from the outside either parallel with the needles already in place or transverse as shown in Fig. 48.

It is not so difficult to do this as it sounds because one finger in the rectum is a great help. When all the needles are in place a tube of radium is guided to the level of the ulcer by means of stiff but flexible wire which is bent outside the anus and placed in the gluteal fold and fastened there with plaster. If the growth is from the posterior wall the tube should be screened in front by a layer of lead rubber fastened to it. This may save bladder disturbance which is apt to follow.

Another method is to enclose needles in rubber tubing which is fastened to lead rubber to which a thread is attached.

The needles are placed in contact with the ulcer. These needles can seldom be kept in longer than two days but can always be replaced. The thread is attached to the buttock by strapping and prevents the apparatus being lost.

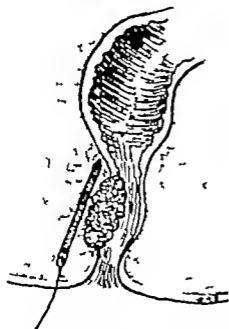


FIG 46 — NEEDLE INSERTED UNDER A RECTAL GROWTH FROM THE PERIANEUM



FIG 47 — NEEDLES INSERTED UNDER AND INTO A RECTAL GROWTH THROUGH A SIGMOIDOSCOPE

The wires of the needles are twisted together those from the inside of the bowel being kept separate from those inserted through the skin and fastened to the buttock with strapping wool is added and a T bandage is placed over all.

Heavy doses of radium given for short periods should be avoided at all costs. Destruction of tissue from radium with the formation of intractable ulcers is a most unfortunate complication especially in cases where a colostomy has not been performed.

Some time ago a friend of mine finding that he had slight discomfort in the rectum consulted a doctor who discovered a carcinoma in the posterior wall of the rectum low down. He sent the patient to a surgeon whose hospital had the rule that radium could only be hired for 24 hours at a time. No colostomy was performed but a large dose of radium was inserted behind the rectal wall for 24 hours. A hole was burned behind his anus into

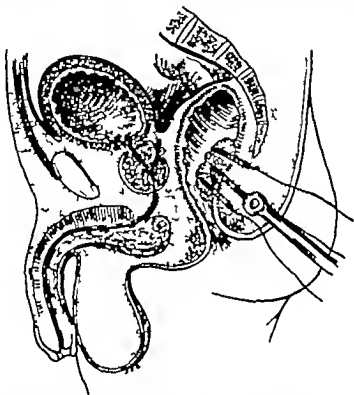


FIG 48 —CARCINOMA OF THE RECTUM. NEEDLES THRUST IN UNDER THE GROWTH FROM BEHIND THE ANUS TO ONE SIDE OF THE COCCYX.

which four fingers could be thrust. This sore gave rise to so much pain that he could neither sleep at night nor rest during the day there was a continual discharge and for the rest of a very miserable life he could not assume a sitting position. The sore never gave any signs of healing during the five months he lived. He died worn out by the suffering he experienced as the result of his radium treatment his cancer had little to do with it. I have carefully avoided this procedure.

Geo H W was admitted to the Freemasons Hospital December 1928. History of trouble with his rectum for eight months.

On examination there was in the rectum a malignant ulcer on the back wall within one inch of the anus measuring $2\frac{1}{2} \times 1$ inches in area. A preliminary colostomy was performed the abdomen was opened and the liver was found free from metastases no glands were felt a piece of the ulcer was removed for examination and found to be carcinoma. Radium needles 60 millimetres in length were run under the ulcer from the back of the anus 44 millimetre needles were run in from the sides of the coccyx. Needles of 27 millimetres were inserted under the ulcer from its lower margin. A tube of 30 milligrammes was placed in the bowel opposite the ulcer. When these needles were removed others were inserted into the bowel tied to a screen of lead rubber this was constantly extruded and rarely kept in place for more than 24 to 36 hours. Considerable irritation of the rectum was caused so that the treatment had to be discontinued from time to time. By this means he was given about 6870 milligramme hours in the course of seven weeks. He was discharged 26th February 1929.

Readmitted 11 March 1929 still with a discharge from the anus. By this time he was tired of treatment and said he would like to have the whole thing taken away. To this I unwillingly consented.

The whole of his rectum was removed and carefully examined. The ulcer had completely healed the mucous membrane round was still congested. Microscopically there was no trace of active carcinoma to be found.

He was apparently completely cured of the local condition but I had not realised this. Time alone will show the presence of metastases. The wound broke down and healed very slowly owing to the influence of the radium. He has now returned to work. Such cases though not conclusive are very encouraging.

I have another somewhat similar case of a woman who was treated in the same way on whom I afterwards operated. Microscopically there was not a vestige of carcinoma left. Her wound is also closing very slowly and she is still in Mount Vernon Cancer Research Hospital.

Growths high up in the rectum

In these cases it is difficult to insert needles in a satisfactory manner through a long sigmoidoscope and though this may be done to a certain extent it is better to attack the growth from the outside.

An operation to expose the growth is performed which is Kraske's old operation much modified. The anus is closed by a purse-string suture or protected by gauze dipped in iodine and sewn over it. An incision is made along the left

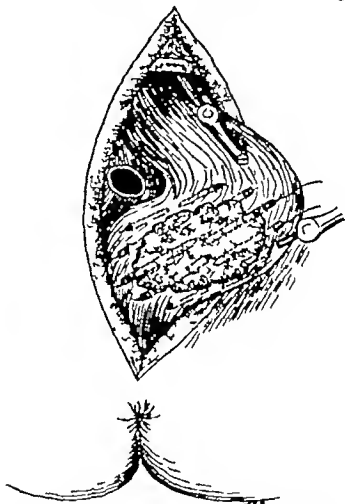


FIG. 49.—A RECTAL GROWTH EXPOSED AFTER REMOVAL OF A PART OF THE SACRUM AND DRAWN OUT OF THE WOUND. NEEDLES INSERTED TO CREATE A SERRATED WOUND AND UNDER THE GROWTH—FORCEPS SHOWN INSERTING A NEEDLE INTO THE HOLLOW OF THE SACRUM.

The wound is then closed temporarily

margin of the coccyx and sacrum. The extent of this incision depends a good deal upon the level of the growth.

The coccyx is removed together with a varying amount of the sacrum. The levator ani muscles are partially divided and the rectum isolated from the back. When all bleeding

has been arrested, the growth is defined and needles arranged round it so as to form an efficient barrage of radium to all parts of the tumour. To do this properly the peritoneum may need to be opened—this however is no disadvantage. The best length of needles to use is from 16 to 27 millimetres and these should be inserted into and along the bowel wall. Sir Charles Gordon Watson uses very short needles and places them in at right angles in the bowel wall. Great care should be taken not to perforate the mucosa as infection may follow. We have ordered similar short needles for use at Mount Vernon Cancer Hospital but we have had no experience with them yet.

One or two 60 millimetre needles may be inserted along the mesentery in the hollow of the sacrum to act upon any glands in the region.

When the growth is satisfactorily surrounded gauze soaked in some antiseptic such as flavine and paraffin is placed in the depths of the wound which is sewn up temporarily. A small rubber tube is arranged leading down to the gauze through which fresh quantities of flavine can be injected.

A tube of radium mounted on a long flexible wire is guided up through the anus to the level of the growth. The wire is then bent into the gluteal fold and fixed in position.

Great care should be taken to prevent soiling of the wound. In many cases if the patient will submit the prone position is an advantage. The tube is removed from the lumen of the rectum in one, two or three days depending on the size of the dose and to a slighter extent upon the level of the growth. I keep in a tube longer below the pelvic floor than above it where the peritoneum might be damaged.

Each day small amounts of flavine are injected into the depths of the wound. At the end of a week the wound is opened, the dressing removed, the needles withdrawn and the wound closed for good. As a rule it heals well.

Geo. A. aged 59 seen January 1927 had a carcinoma situated in the posterior wall six inches from the rectum. History had been indefinite rectal trouble for about six months.

His abdomen was opened and explored and everything proving satisfactory a preliminary colostomy was performed

A month later the coccyx and part of the sacrum were removed and the rectum isolated. Fifteen 27 millimetre needles of 2 milligrammes each were inserted into the bowel wall round the growth and a 30 milligramme tube placed opposite the growth in the lumen of the bowel.

The rectum was packed round with gauze dipped in paraffin and flavine and a fine tube placed in the bottom of the wound which projected above the dressings and through which extra flavine could be delivered to the depths of the wound

The wound was temporarily closed. The tube was removed after three days and the needles after seven a dose of 5.00 milligramme hours being given. The wound was then closed.

The wound healed completely in about six weeks. The growth became much smaller. In April the tube was again inserted for two days.

He had reported since from time to time but apparently is free of his trouble.

Inoperable cases

In inoperable cases where a colostomy has been performed but the condition of the liver has rendered further procedure useless great benefit may be obtained by placing a tube of 30 milligrammes of radium in the stricture through a sigmoidoscope either from the anus or through the colostomy wound.

The pain is eased and the discharge lessened and the good effect on the patient's mental aspect should not be overlooked. In two cases what apparently was a tight stricture preventing the passage of water became sufficiently relaxed to allow me to pass a stomach tube through it and the ulceration completely disappeared.

E. T. C. aged 74 sent me by Dr Gavin in September 1928

History He had suffered alternately with constipation and diarrhoea for months but this was rather indefinite because as a young man he had been operated upon for piles and his sphincter had been destroyed.

Lately he had had considerable griping pains and a lump had appeared in the left side of his abdomen. He had now developed obstruction. His abdomen was explored the same day. A ring

stricture was found gripping the bowel high up in the sigmoid flexure. Metastases were felt in his liver

November 26th a tube of 5 milligrammes of radium was inserted by means of a narrow sigmoidoscope through the colostomy opening and gripped by the stricture and left in place for three days. This caused relaxation of the stricture and on December 14th a tube of 30 milligrammes was inserted and lay quite loosely in what had been a tight stricture and was left in for two days

This was repeated in March when the stricture could hardly be recognised. His liver by this time was enlarging rapidly he became jaundiced and lost weight and suffered great pain. He died 14th June I had no opportunity to examine the site of the primary growth.

Anal growths

This like squamous celled carcinoma responds readily to radium. The region drains to the inguinal glands. Here perhaps a colostomy may be avoided. The treatment can be divided into two parts 1 The local growth. 2 The glands

1 The local growth

The needles should be fairly long about 44 millimetres and contain 2 milligrammes. They should be inserted just outside the growth and pushed in close to the floor of the ulcer being guided by a finger in the rectum.

The wires should be fastened into the gluteal fold. Strapping should be applied close to the anus and the parts especially the needle holes smeared with white vaseline to which is added 5 per cent eucalyptus oil. If a motion takes place the parts should be washed the vaseline filling up the needle holes will prevent them being infected. The needles should be inspected each day as they are apt to work out from movements such as coughing or straining. They are left in position from four to eight days depending on the size of the ulcer and the number of needles

The patient should be told of the presence of the needles and the wire under the plaster. I lost two needles through neglecting to do this as a patient found the wires and pulling

on them withdrew the needles which he threw down the W.C. and the loss was not discovered till next day. The needles were never recovered.

2 The glands

These are situated superficially in the groin and extend over an area of less than 10 centimetres or four inches long by two inches wide. A plaque of Columbia paste is made for each side. Ten 2 milligramme needles placed at a distance of a centimetre apart will cover the area and in ten days will give a dose of $(20 \times 10 \times 2.4)$ 4800 milligramme hours which should be ample. A careful watch should be kept on the glands in the future.

The comparative merits of radium and surgery

It is but right to state that there is less to be said in favour of radium and more in favour of the knife in the treatment of malignant disease of the rectum than in any other part of the body. Also while surgery can make out a good case for itself at the present moment radium is hardly able to make out any case at all. The difficulties of treating malignant disease of this area are peculiar but not unexpected. Carcinoma here is almost entirely adeno carcinoma or a specialised type with highly differentiated cells. It has been noted elsewhere that the more embryonic a cell is the more radio-sensitive it is and therefore the more easily is it killed. The adeno carcinoma of the rectum is hardly less specialised than the normal type of cell and therefore very little more sensitive so that the malignant cell is killed by a dose which is only slightly less than that which will kill the normal cell. This difficulty we have yet to overcome.

The operative school led by Ernest Miles and Lockhart Mummery of London, Sir Gilbert Barling of Birmingham and Hartmann of Paris all unhesitatingly condemn the use of radium for malignant disease of the rectum. This is only natural until workers with radium can show figures which approach the figures produced by surgeons. The surgical results though not brilliant are what surgeons are accustomed

to call good in dealing with carcinoma. Let us examine the results of the three English surgeons.

Barling quotes the figures from three Birmingham hospitals and several surgeons. The operative mortality in 120 cases was 15 per cent. but out of 58 who recovered from the operation there were 36 per cent. of 5 year survivals and 25 per cent. of 10 year survivals. In discussing radium with which he is not favourably impressed he says of the 26 treated that all were in an advanced state of disease and inoperable. Among this small number perirectal suppuration is apt to occur in two a permanent fistula formed mild pyrexia is usual and secondary haemorrhage may happen one dying from this complication. From this it is evident that the dosage left much to be desired and it is useless to compare these advanced inoperable cases with those which were operated upon.

Miles states that he had performed 300 abdomino-perineal operations and had a recurrence mortality of 30 per cent. (presumably for 5 years) his mortality had been 60 cases in other words one in five had died from the operation.

Mummery's figures are a little more difficult to deal with. His mortality was 3.5 in private and 8.6 in hospital cases of 130 cases operated upon more than 5 years ago 16 were dead from other causes or untraced 57 had recurrences and 57 were alive without recurrences none apparently had died of the disease. Of radium he says that no case that can really be claimed as a cure has yet been brought forward here a 5 years survival is meant. This is unfortunately quite true but what is equally true and just as unfortunate is that no one with any pretensions to knowledge of radium has treated rectal cases in this country for more than four years at the outside and therefore the operative surgeon can demand such cases with every safety as they are not there.

A more hopeful note however has been struck by Sir Charles Gordon Watson who three and a half years ago visited Professor Neuman at the Brussels Clinic and learned his methods and has employed them in 27 cases since that

time With one exception all have improved. The figures are too small and the time too short for ultimate conclusions to be drawn The same applies to the figures of Professor Neuman and Coryn Here 59 cases were treated 46 being borderland or inoperable cases of these eight are 3 year cures out of 40 cases

The difficulties of treating rectal carcinoma are now fully recognised and there is no doubt that they will be solved in time but at present radium followed by excision seems according to Sir Charles Gordon Watson to be the procedure of selection

CHAPTER XI

OESOPHAGUS

MALIGNANT stricture of the oesophagus is nearly always caused by carcinoma only rarely by sarcoma.

The three situations where it occurs most frequently are

(1) Opposite the cricoid cartilage about 6-7 inches from the incisor teeth

(2) Opposite the bifurcation of the trachea where the oesophagus is in close relation to the left bronchus just above the level of the body of the fifth dorsal vertebra and about nine inches from the teeth

(3) In the terminal inch just below the diaphragm and about 16 inches from the teeth

In men the cervical situation is least common according to Von Hacker Von Bergman and Lillenthal consider the middle portion but according to Keen it is the lower site which is least affected.

In women curiously enough the upper site is the commonest

The carcinoma spreads slowly round the tube and constricts it later it penetrates the muscular wall and lastly invades the outlying tissue. The glands are only infected late. The lower cervical glands are infected when the growth is in the cervical portion and the thoracic or mediastinal glands when it is in the lower two portions

Methods of treatment

Carcinoma of the oesophagus has hitherto been regarded as beyond hope of cure by the surgeon Temporary palliation by means of tubes inserted through the carcinoma was advocated for want of something better though it was

recognised that nowhere else in the body would carcinoma be treated in such an unsurgical manner but apart from prolonging life by a gastrostomy nothing else could be done

At the present no one method of treatment has the lead every method is being tried and all are in the experimental stage The insertion of seeds through the oesophagoscope though very dextrous must fail as the lower part of the stricture cannot be reached The usual method is to introduce into the stricture radium or radon and leave it there for as long as possible The dose varies from 10 to 100 milli grammes and may be inserted in a special tube or apparatus

There is no doubt in my own mind that a preliminary gastrostomy should be performed in every case This allows the surgeon to have unrestricted use of the oesophagus gives rest to the growth and allows the patient sufficient nourishment If necessary the gastrostomy opening can be allowed to close later

Before inserting the radium it is better to give the patient a general anaesthetic With the oesophagoscope a view is obtained of the stricture and if necessary a small piece can be removed for microscopic purposes

It may be necessary to dilate the stricture with a fine bougie in order to insert the radium The tube containing the radium is inserted into the stricture and should be so shaped as to be gripped by it A strong silk thread is attached to the eye of the tube and knotted round the ear after being fastened to the cheek by plaster

If it is wished to apply the radium frequently for a short time only the patient must become used to the passage of a bougie the tube should then be fastened to the bougie and passed into the stricture the upper end of the bougie being fastened to the forehead.

At King's College Hospital the patient is encouraged to swallow thread for a few days when about six yards have been swallowed and the end is presumed to be in the small intestine a metal bougie with a hole in the tip is run along the thread and so guided through the stricture A radium con

tainer holding 50 milligrammes of radium is fixed between the bougie and its whalebone guide when the bougie is felt to tap the lower end of the stricture the radium is in the lumen of the stricture. The whalebone is fixed to the fore head.

The container is kept in place for one hour daily for four days then left off for two or three days. If there is any reaction this interval is increased. Later the radium is left in for three hours. A small dose of morphia and atropine is necessary as without the atropine the saliva collects unpleasantly.

Two years ago Mr. Abel passed a bougie on a man after accurately measuring the distance and attached 120 milligrammes of radium in rubber tubing to the bougie and inserted this into the stricture. This was left in for eight hours every other day for fourteen days. The carcinoma completely disappeared and the man is still well.

I have used a 60 millimetre needle screened only by 5 millimetres of platinum which makes it very slender enclosed in a fine rubber tube and attached this to a bougie or ureteric catheter and so passed it into position. A ureteric catheter being flexible can be brought out of the mouth or passed in through the nose and can be strapped to the cheek without being irksome.

It is possible to place radium round the growth outside the oesophagus as well as inside the stricture. There is no great difficulty in doing this in the neck where the oesophagus can be exposed.

In one case I managed to pass needles into the upper part of the thorax to the level of the aortic arch from the root of the neck.

I have also resected the posterior ends of the ribs and found that it was possible to arrange needles in close proximity to the growth. As the case was far gone nothing was to be expected from this but with an early case I should not hesitate to repeat the experiment.

I have also inserted radium round the lower part of the

oesophagus through an abdominal incision in this case the growth had invaded the stomach and was quite inoperable.

Mr Tudor Edwards has devised a method of exposing the lower oesophagus transpleurally from the left side after inducing a collapse of the lung some days previously by the production of an artificial pneumothorax.

Though I used to see patients treated with radium by my late colleague, William Hill as far back as 1909 no case has yet been cured and I know of none which has passed the five year limit. Berard and Saignon stated the same thing in 1926. But even in Hill's cases great amelioration was obtained. In one no discernable cancer remained though the patient died of infected glands. In another the oesophageal tube he wore was left off and ordinary meals could be taken and he put on two stone in weight and died some years later of pulmonary invasion.

External pressure on the oesophagus

In those cases where the obstruction of the oesophagus is due to metastases secondary to primary growths elsewhere relief may be obtained by treatment of the mass if it is situated in a position where it can be got at. Fortunately pressure on the oesophagus is usually produced low down in the neck and very seldom actually in the thorax. Radium will sometimes give very great relief. The following curious case illustrates this very well.

Miss D. aged 67 was sent to me on the 6th April 1929 by Dr Henderson with obstruction in the oesophagus and inability to swallow.

History She had had her left breast removed for cancer in 1916 and her right removed in 1919. She had remained well till November 1927 when a swelling on the left side of her neck appeared while she was abroad and she had been sent home for radium treatment. The old fashioned external application of radium had been applied for 16 hours for two consecutive days in May, October and February. This did not seem to make any difference so she had left it off. Last November she began to notice difficulty in swallowing and this became worse she was reduced to fluids and now could not even swallow them not even

her own saliva. Her voice began to get husky a year ago. She had at last gone to her doctor.

On examination she was very thin and frail and the removal of both breasts accentuated this. There was a mass of glands low down upon the left side of her neck passing into the thorax attached to the skin and obviously either surrounding or pressing upon the oesophagus. She was too nervous to allow examination even of her larynx.

A gastrostomy was performed at once and a stomach tube inserted through the opening she was fed immediately. No bougie could be inserted past the stricture down the oesophagus. Seven needles of 27, 37 or 44 millimetres in length were inserted downwards and inwards into the mass of glands towards the oesophagus. These were removed after 5 days giving her a dose of 1500 milligramme hours. By that time there was a perceptible difference in the size of the mass and she could now swallow thick soups. On the 19th the mass in the neck could scarcely be felt and swallowing had greatly improved. When she left the nursing home after three and a half weeks she could nearly swallow normally and wanted to remove the stomach tube. She was warned however to leave a plug in for future use.

At the end of June some difficulty returned and she had 660 milligramme hours into the glands which could be felt just protruding from the thorax and she went out better. She had become now much fatter. In August she could swallow solid food and no longer felt a lump in her throat.

The condition must of course return as the mass felt in the neck was only the upper end of a mass in the chest which cannot be dealt with at all but the immediate result was all that could be desired.

Failure of the treatment

The causes of failure are obvious and chiefly physical. Carcinoma of the oesophagus is the same variety of carcinoma as in the mouth and pharynx and therefore is sensitive to radium. Why then can it not be cured if taken early? Alas it seldom is taken early because it is inaccessible to sight or touch and can only declare itself by symptoms. A patient may have no symptoms and then may have a slight difficulty in swallowing for months before he begins to trouble about it. Then he may go to a doctor who treats him for indigestion (I am quoting the case of a friend) and so more time is

wasted before he is examined by X rays or is led to a specialist to have an oesophagoscope passed. I think we may take it that by the time a diagnosis is made the carcinoma must be regarded as late if not very late and the chances of cure by radium have correspondingly diminished.

Again the exact length of a well-established stricture from carcinoma is difficult to determine and it is useless to apply radium to the first inch of a four inch stricture and expect a cure to result. To meet this Ledaux and Hays have recently introduced a method by which a retrograde opaque meal can be given and the length of the stricture determined. In a long stricture it is difficult to arrange the radium to act upon the whole of it equally and effectually. Lastly we have not yet established the best method of introducing the radium nor the normal dose to administer nor the length of the administration. The dose and the time have been largely dominated by the physical surroundings, such as the tolerance of the patient and the collection of saliva.

Experiment alone will answer these questions and then progress will be made but at present no good results can be claimed for any method yet devised of treating carcinoma of the oesophagus—all perish miserably whatever we do. Any procedure which can better this is a great step in advance.

CHAPTER VII

THE UTERUS

By MR MALCOLM DONALDSON

Physician Accoucheur to St. Bartholomew Hospital and Gynaecologist to Mount Vernon Cancer Research Hospital, Northwood.

It has well been said that the history of radium therapy is the history of radium in gynaecology as it is in this field that the value of radium in connection with malignant diseases was first demonstrated on a large scale. Moreover carcinoma of the cervix is a comparatively radio-sensitive growth and there are very few vital organs near which might be affected by wrong or at any rate inferior technique so that good local results have been obtained even by the most crude methods.

Before going into the details of treatment of cancer of the uterus by means of radium it must be realised that radium therapy is in a state of evolution and what are considered the best lines of treatment to-day may be out of date in the course of a year or so. One of the difficulties of being dogmatic as to the right technique arises from the facts that first statistical comparisons of results are based on a five years survival rate and secondly that it is not always easy to be certain that cases of equal severity are being compared.

There is however one important point in which malignant disease differs from other conditions in that we can exclude for practical purposes the possibility of spontaneous cure. All treatment so far has been empirical as very little is at present known as to the exact action of radium on tissues. One of the things definitely established however is the fact that all quickly-growing tissues are affected to a far greater extent than the more stable tissues and this accounts for the selective action of the rays on ovaries

testes and malignant cells. At one time it was thought that the cell was actually destroyed whilst in visible mitosis but as all mitosis ceases soon after the radium is put in position this explanation is now known to be erroneous

Dosage

When speaking of a dose of medicine a certain weight of a drug is prescribed on the assumption that the same proportion of that drug is absorbed and that the resulting action will on the whole be very much the same. When however radium is being used the problem is very different. The radium is not absorbed and the effects of the radium depend on many factors. The most important of these factors is the amount of energy received by the individual cell and this depends on the amount of radium used the distance it is from the cell the time during which it is left in position and the thickness and density of the walls of the container. Although it is possible to define dosage as the weight of radium element multiplied by the duration of exposure this alone in practice gives very little information because the intensity of the irradiation follows the same law as light namely that it diminishes inversely as the square of the distance. In other words it is reduced very rapidly the further the radium is from the cell.

The only way of conveying to another person exactly what treatment has been carried out is to state (1) the weight of radium element (2) the number of containers (3) the size of the containers (4) the filter that is to say the thickness and material of the walls of the container and (5) as far as possible the position of the containers in relation to the growth and (6) the length of time that they are left in position. This however has not yet been adopted universally.

Having now made clear the necessity for an accurate description recording dosage it is necessary to discuss the problem of how that dosage should be made up. It would be a simple matter if it were certain that the destruction of a carcinoma cell depended simply on the amount of energy

received. If this were true it would not matter whether 100 mgrms. was used for 1 hour or 1 mgrm. for 100 hours. Unfortunately this is not the case and one of the problems for which an answer is being sought is whether it is better to use a small intensity for a long time or a large intensity for a short time. Speaking purely from the clinical side there is no doubt that for certain types of growth particularly slow growing tumours it is better to apply a small intensity for a long time than to give a large intensity for a short time. Perhaps one of the most striking examples of this is afforded by carcinoma of the vulva. It would appear at the present state of our knowledge that the quicker the rate of growth of the tumour the less important is the time factor. If the principle of a long-continued exposure is to be carried out it is necessary to divide the radium into multiple foci and to distribute it as evenly as possible rather than to concentrate it in one container. If the radium were concentrated into one container the intensity near that container would be so great as to cause severe necrosis and damage to healthy tissue. The only alternative to this plan of using multiple foci is to have a very large quantity of radium for example 5 grammes applied a short distance from the surface of the body. In the case of carcinoma of the cervix there is still some discussion as to what is the optimum intensity and the optimum time factor and therefore the various techniques will be described in detail.

Carcinoma of the cervix

Carcinoma of the cervix occurs in multiparous far more frequently than in nulliparous women and it is probable that nearly 5000 women die from this disease in the United Kingdom each year. That this state of affairs should exist is largely due to the ignorance of women concerning the importance of the early symptoms and the natural dislike to face a pelvic examination. If every case was diagnosed within a month of the first symptom the mortality from this disease would probably be diminished to about half or

even less Still further would it be diminished if every woman who had had a child was examined systematically every six months

This is not the occasion to discuss the question of operation versus curietherapy although in the mind of the writer the future lies entirely with the latter treatment it is sufficient to state here that the statistics of five years survival in the best radium clinics already show as good a percentage as that obtained by operation and of course without the large initial mortality which inevitably accompanies any considerable series of Wertheim's hysterectomies

Technique of radium treatment.

The question of technique is as yet by no means settled and speaking generally it may be said that there are two schools

The first of these is that originated by the clinic at Stockholm which believes in a rather large intensity with a comparatively short duration of exposure This technique which undoubtedly gives very good results has as its underlying principle the avoidance of injury to the normal tissues on the assumption that the patient has a definite cancer resistance which is lowered if the normal tissues around the growth are badly injured. It must be admitted that there is a certain amount of scientific evidence for a cancer resistance of the body but in the writer's opinion it is improbable that this resistance is in any way lowered by prolonging the exposure and using a much smaller amount of radium.

In describing the technique it will be as well to summarise briefly the treatment as published by Dr Heyman in *Acta Radiologica* vol 10 Fasc 1 He states that as a rule three treatments are given the second application is carried out one week after the first and the third three weeks after the second The shape of the applicators varies to some extent to meet the requirements of each individual case but the same principle namely of putting radium into the uterine cavity and applying it against the surface of

the growth in the vagina is carried out in all cases. The filter used is the equivalent of 3 mm of lead and in addition to this a secondary filter of thin rubber is used over the container which goes into the uterine cavity and one consisting of paper cotton wool and oiled silk for the containers in the vagina.

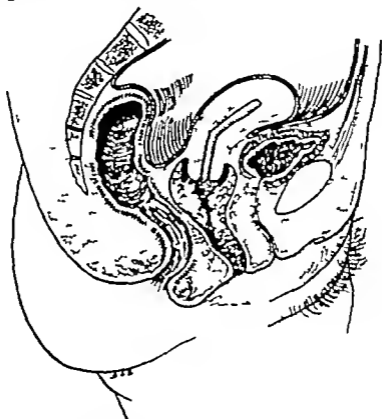


FIG. 50.—CARCINOMA OF THE CERVIX.

A tube in the uterine cavity and boxes or tubes (black) arranged round the cervix, the rectum and bladder packed off as far as possible.

As a typical series of treatments the following example may be quoted —

1st Treatment

In the uterus	(4 tubes)	40 mg el	$\times 19$ hrs	=	760 mg el hrs
vagina	(12 tubes)	78	$\times 19$ hrs.	=	1,480

2nd Treatment

In the uterus	(1 tube)	43 mg el	$\times 21$ hrs	=	900 mg el hrs
vagina	(10 tubes)	71	$\times 21$ hrs.	=	1,490

to 9 000 mgrm hours Since 1923 24 X rays have been used in addition

Results

Of 41 operable cases treated between 1919 and 1923 19 were living at the end of 5 years (46.3%) of 112 border line cases 33 were living at the end of five years (29%) of the 206 inoperable cases treated 24 were living (11.1%)

Needle technique

This technique is at present not so extensively used as that described by Heyman. Among other centres it is being tried at St. Bartholomew's Hospital. A typical treatment is as follows

Only one vaginal application is given lasting a minimum of 144 hours total amount of radium used=50 mgrm. of element distributed in 20 to 25 needles. These needles have an intensity of 1 mgrm per 15 mm active length some of the needles contain 2 mgrm other 3 mgrm. The filter is 0.5 mm. or 0.6 mm of platinum

The patient is admitted a few days before the operation and the growth cleaned up as far as possible by means of douches. At the time of operation she is put under an anaesthetic and placed in the lithotomy position. In all cases a small piece of growth is taken for microscopic examination before the insertion of the radium. The needles are then placed in a circle round the growth at about a centimetre distance from each other. In addition to these a few needles are placed upwards and outwards towards the base of the broad ligaments. In the case of large neoplasms some of the needles are placed in the centre of the growth itself. The whole vagina is then packed tightly with gauze wrung out in flavine not stronger than 1 in 4000. In very ulcerated growths a rubber tube is placed in the centre of the plugging so that the vagina and gauze can be irrigated daily and this diminishes the offensiveness of the discharge. At the end of six days the plugging and radium are removed without an anaesthetic and the vagina is douched daily for at least four

weeks In the majority of cases there are no adverse symptoms following this treatment but in a certain number severe proctitis occurs which as a rule however does not last more than two weeks

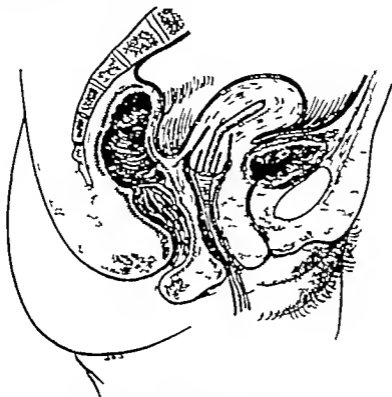


FIG 51.—CARCINOMA OF THE CERVIX.

A tube inserted into uterine cavity and needles shown inserted into the cervix and into the angles of the fornices

It is not possible at present to compare the results of these various methods but there is a suggestion that local recurrences are less likely to occur in the case of the longer dose although survival rate is possibly greater in those patients treated by the Stockholm technique. Whichever technique is used for the vaginal application of radium the local disappearance of the growth is almost a certainty. In the writer's experience the failures of the advanced cases are due to the growth continuing to extend in the glands and more inaccessible parts of the pelvis. For these extensions there are two lines of treatment being carried out at St Bartholo-

mew s (1) by means of X rays (2) by means of intra abdominal radium

Technique of intra abdominal radium

It is to the Brussels Radium Institute that we owe this form of treatment. The technique they used in 1919 consisted in opening the abdomen and when the posterior layer of the broad ligaments had been incised placing 20 mgrm of radium element in a single tube at the base of each ligament. In addition to this they sometimes put needles into the uterus. The sutures from these tubes were carried out through the lower end of the abdominal incision and the whole pelvis packed with 6-8 yards of gauze. At the end of 4-5 days this was removed with or without an anaesthetic.

The present writer modified this technique by using needles instead of tubes. Thirteen cases were treated during 1923-24 with this technique.

Of these 13 cases one was of the 1st degree and is living and well after 4 years. Four were of the 2nd degree and of the four cases two are living after 5 years although the latest report from one is not very satisfactory. Two have died one after 14 months and the other after 7 months. Six were of the 3rd degree and three of these six are living after 5 years or more and three have died having lived less than 1 year. Two were of the 4th degree and one is living after 5 years and the other died after 1 year 10 months.

It will be seen therefore that of the 13 cases six are alive after five years and one has lived for four years and shows no sign of the disease.

Present technique

The intra abdominal insertion of radium is usually carried out about 6-8 weeks after the vaginal application—that is to say when the local external growth has disappeared and all ulceration healed. No attempt so far has been made to combine the intra abdominal application at the same time as the vaginal merely on the theoretical grounds that whilst

there is an infected area in the cervix and fornices it is perhaps not wise to do anything to the abdomen and parametrium which might lower the resistance to that infection

The patient is put into the Trendelenberg position and the abdomen opened a general examination is made of the lower aortic glands in addition to the pelvic organs and the iliac glands The uterus is pulled forward the parietal peritoneum is picked up with forceps and the needle inserted leaving only the eye of the needle protruding from the peritoneum The suture is put through a small portion of the peritoneum below the level of the needle eye and the knot tied over a flat glass bead to prevent cutting through the thin peritoneal tissue and to help in finding the needles later

The needles are placed at a distance of $1\frac{1}{2}$ cms from each other starting at one sacro-iliac synchondrosis and ending at the corresponding joint of the opposite side In addition four or possibly more needles are placed in front of the broad ligaments in the hope of eradicating the disease from the obturator glands The ends of the ligatures are tied together and pushed down into the pouch of Douglas The abdomen is sewn up completely and the radium left in situ for seven days At the end of this time the abdomen is again opened and the radium removed

An objection to this technique is the second laparotomy at the end of a week but up to the present it has been felt that in order to keep them in position the needles should be sutured to the peritoneum which makes it impossible to pull them out In addition to this they are often placed at an angle to the line of traction and damage might be done if pulled out blindly Dodd of the Westminster Hospital has modified this technique by using radium needles in catheters placed retro-peritoneally so that they can be withdrawn through stab incisions In addition he combines this with excision of the glands

STOMACH

Cancer of the stomach is an extremely common affection in both sexes. It is of the adeno-carcinoma type but is not insensitive to radium. Our difficulty however lies in the fact that this radio-sensitiveness is shared by the normal wall of the stomach and intestines. It is therefore difficult to administer a lethal dose to the growth without injuring the adjacent mucous membrane.

Carcinoma of the stomach is a rapidly fatal disease unless diagnosed and widely removed at an early date. So often affections of the stomach linger in the hands of the physician till long after the time at which surgery is likely to be effective. The indefinite nature of the symptoms almost makes this necessary. The results of partial gastrectomy and their estimation are uncertain. Balfour shows a series of 1000 cases of which 52% were alive at the end of three years if no extension of the disease had been observed. No one else can approach such figures. While the same writer gives 19% living of those in whom the glands were infected. Sir Holburt Waring on the other hand represents the general results of surgery as below 15% for all cases and we must admit that this is probably correct.

The cases therefore which are likely to undergo radium treatment are those in whom it is deemed that they are unsuitable even for exploration or those who have been explored and for whom nothing can be done. These will include carcinoma of the cardiac end, leather bottle stomach and carcinoma which has spread too far. In those cases where a short circuit will give relief this will probably have been performed.

Treatment

It can be said at once that there is no treatment for cancer of the stomach yet laid down. The technique is still to be worked out. Various methods are being tried. The stomach is exposed and the situation and extensions of the disease made out.

Seeds

Seeds can be inserted into and around the growth into the glands and into or around the secondary growths. Large numbers of seeds must be at hand to be used if needed on the other hand they will be wasted if not wanted. This alone will limit their use. They must be left in permanently. I know of no cases where they have been a success.

Needles

If needles are used the blunt or bullet pointed are best as being less likely to change their position. They should not contain more than .5 or at the outside 1 milligramme of radium. They can be inserted into and around the growth and left in position while the wound is temporarily closed. The threads can be brought out of the wound through a drainage tube or tied together and left inside. Later they can be removed either by traction on the threads through the drainage tube—a rather dangerous proceeding—or the wound is opened and the needles removed and the wound sewn up again.

The needles may be threaded into a fine catheter which is tied at the ends. The blunt points will prevent the needles piercing the wall of the catheter and escaping. The end of the catheter can be inserted between the layers of the omentum and made to lie along the greater and lesser curvatures of the stomach. It can be wrapped round the pylorus or coiled round glands. The end of the catheter protrudes from the wound and can be removed by pulling on the end any time that is thought necessary.

Surface Radiation

Plaques of Columba paste can be fitted over the abdomen and radium applied in various amounts either apart from or following the insertion of needles. An encouraging case of this nature was published by Cahen who had previously fixed the growth to the under surface of the skin of the anterior abdominal wall. The patient gained 24 kilos in three months.

I excised a pyloric cancer from one patient and a recurrence later appeared in the abdominal wall sewn probably at the time of the operation. Surface radiation was given and the nodule disappeared. Later other nodules were felt and he is still under treatment and is going on satisfactorily.

Tubes

I have treated cases in which nothing surgical could be done by placing tubes containing 10 to 30 milligrammes of radium screened by 2 millimetres of platinum and 2.5 millimetres of silver in the stomach itself. The tube is attached to a stout linen thread and the patient swallows it and keeps it in position from one to three hours a day, altering his position so as to distribute the action of the radium over a large area of the stomach wall. By posturing the patient the radium can be brought more or less to any desired place in the stomach.

Mr R. L. aged 59 sent me by Dr Cameron Morris

History There had been indigestion and gastric pain for four months. He had lost two stone in weight. At the laparotomy it was found that the greater curvature of the stomach from the pylorus to half way along was a mass of cancer which was invading both the anterior and posterior wall. It was not thought worth while even to do a gastro-entrostomy. He recovered from the operation and had a course of lavage. On 21st Dec. 1928, he started to have radium. A well-screened 30 mg tube with 2.5 mm. of silver as additional screenage attached to a linen thread was swallowed and he reclined on his back, turned to his left side.

He kept the tube down for 1 to 3 hours altering his position from time to time. This was repeated on eight separate days in the course of three weeks. He was then so bad that his brother was sent for and he took him over to Belfast to end his days.

Nothing further was heard of him till 15th August 1929 when Dr Huston wrote to say he had improved surprisingly and would like me to know he was now travelling for his business firm in the Balkans. How long he will last I should not like to say but he is much better now than when I saw him a year ago.

CHAPTER XIII

PROSTATE BLADDER AND PENIS

CARCINOMA of the prostate is alveolar in type not unlike that of the breast but in my experience it does not react to radium as readily as the breast. This however may not be due either to the growth or to the radium but to other considerations.

I suppose every surgeon admits that operative procedure on carcinoma which affects the prostate anywhere except at its centre is about the worst possible thing to attempt. Such operations are nearly always incomplete they cannot be radical and partial operations merely stir the growth into activity and fascial planes are opened up which allow spread to take place with increased rapidity. Apart however from such attempts there was no other policy possible till the advent of radium except to look on helplessly at the inevitable spread of the disease.

For this reason radium seems peculiarly suitable for the treatment of cancer of the prostate and inoperability and extraprostatic extensions merely emphasise its importance while in the decrepit and broken-down patient with renal weakness and urinary trouble it is obviously our only means of combating the disease.

There are many methods of introducing radium into the prostate but most workers have abandoned the introduction of radium through the urethra or through the rectal mucous membrane. I never tried the former and only tried the latter once. I found it reacted more upon the rectum than on the prostate but perhaps this was because I had not the courage to thrust the needles deeply enough.

We must recognise the physical difficulties which have to

be encountered in dealing with cancer situated as far from the surface as cancer of the prostate. It is these and not the disease which make our task so difficult.

In an early case we may know that the disease is more in one lobe than in another that it is spreading largely in such and such directions but its exact position cannot be located. In later cases where it is fungating into the bladder Diathermy may be needed to destroy the prominent portion before the base becomes visible and its extensions can only be guessed at.

It is impossible to place the needles in position round the growth so as to destroy its growing edge with anything like accuracy.

The position of the needles cannot be seen through a cystoscope unless they pierce the bladder mucous membrane which is a thing we wish to avoid at all costs and the finger in the rectum can only tell us vaguely their position. Perhaps with needles with screening of 6 or 8 millimetres of platinum better results may be obtained and we shall perhaps get less reaction of the normal tissues. We shall shortly have an opportunity to try these at Mount Vernon Cancer Hospital at Northwood.

The perineal route

Here needles and small tubes are inserted into the lobes of the prostate through a suitable trocar and canula thrust in through the perineum. To do this with any accuracy requires skilled help and demands that one should look through a cystoscope which must be held by an assistant have one finger in the rectum and at the same time introduce the needle. This is a feat which I find verges on the acrobatic and therefore state that the accurate placing of the needles is almost impossible.

Marion followed by De Nabias advocates the use of 10 milligramme tubes into each lobe and a dose of 12 000 milligramme hours in three weeks.

Other continental workers such as Papin and Maurer have

advocated the introduction of radium more accurately by transverse perineal incision tubes of 5 milligrammes or needles being placed in position Gaudy and Van Dooren combine this with a supra pubic drain this is hardly necessary if a catheter is tied in If sepsis can be excluded perineal incision seems to be the best method suggested yet

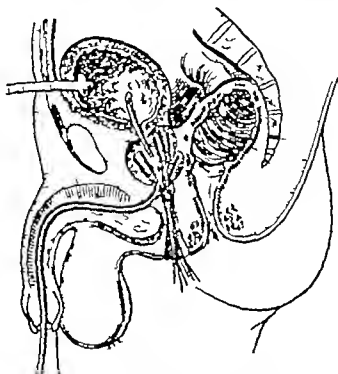


FIG. 5.—CARCINOMA OF THE PROSTATE.
Needles inserted from the perineum.

I think several needles with smaller doses placed in each lobe and as near the growth as possible must act in a better manner than a tube and is more in keeping with the treatment advocated throughout this book for cancer elsewhere in the body namely of multiple small foci of radium over long periods

As a warning I may mention that in one of my early cases two needles escaped the view of the cystoscope and entered the bladder I was able to identify the wires and withdraw them into the prostate without mishap

In another case when I was trying the effect of radium on an adenoma I had mounted the needles with silk thus cut from the eyes of two needles which were left in the depths of the tissue I had to open the bladder above the pubis and remove the prostate and so free him from the needles. Luckily for me the old gentleman was only too willing to have this done as a friend of his had had his prostate successfully removed and he did not hold with new fangled ideas about radium.

Four needles may be placed in each lobe and left in for a week the wires being strapped to the thigh. A catheter should be tied in as swelling and congestion of the prostate are liable to occur. There may be some spasm of the sphincter excited by the radium an ointment containing 10 per cent of novocaine should be smeared on the catheter to combat this.

The supra pubic route

This is an extremely useful method of introducing radium and can be used in cases where the bladder has been opened and cancer found unexpectedly also in those cases where a permanent supra pubic opening has already been established and those where the intravesical surface of the prostate is involved. It is more suitable in late cases but should be avoided in early ones if possible. The radium in whatever form it is used seeds needles or tubes can very well be introduced by suitable instruments through a narrow sigmoidoscope such as I use for placing radium into growths through a colostomy wound.

Seeds

These can be placed in position to destroy purely superficial growths in the prostate and bladder by means of a cystoscope. Used in this way however their scope is very limited.

Through a supra pubic opening a seed introducer can be used and as many seeds as desired can be placed at any depth required and efficient radiation carried out with the

minimum of trouble. The threads which should have been previously run through wax so that they do not become soaked with urine are brought out of the cystotomy opening and attached to the abdominal wall.

Needles

Needles of 27 millimetres long are the best to use in the prostate but in large growths 37 millimetre needles can also be employed. In these cases the needles should be mounted with thread rather than wire and the threads should be coated with wax. The needles should be placed as accurately as possible round the growth the larger needles passing through the prominent or fungating portion. A finger in the rectum is a great help. Experience alone can teach the number of needles required.

It will be necessary to wash out the bladder during the placing of the needles as the vision is easily obscured by blood. A catheter fixed in the bladder is useful and a solution of adrenaline and silver nitrate is a necessity.

The needles should be left in for 10 days and a dose of from 5000 to 9000 milligramme hours can be given.

After placing the needles in position the threads can be led through the wound in a catheter and should be fixed to the abdomen by strapping.

The same technique can be followed in placing tubes though I have only used tubes on one occasion and then in conjunction with needles.

Results

The result of almost any kind of radium treatment in cancer of the prostate is good for the time being. In early cases the prostate becomes softer and more mobile and micturition soon becomes normal but it is too early to speak with confidence on the ultimate result of my cases. In late cases the pain is relieved by the diminution of the congestion the bleeding stops or diminishes and the cystitis improves.

After successful treatment the patient is very much improved bodily and his condition less irksome. I have never seen recto-vesical fistulae form nor have I known any ill results from treatment

On the whole though the results may not be so good as in the tongue it is the physical difficulties which we have to contend with that are the cause of this and these we should be able to surmount in time. We can say that our results at the present are quite as good as those of surgery and are without the disadvantages and drawbacks which accompany surgical procedures

BLADDER

Carcinoma of the bladder is usually of the squamous epitheloid type and is therefore highly sensitive to radium only very occasionally when growing from the base of the bladder is it of the adeno-carcinomatous variety and is then more resistant to treatment

There is a great advantage in treating patients in the early stages of the disease before chronic sepsis has set in. In these cases where chronic urinary sepsis is established every effort should be made to diminish it and render the urine acid

Carcinoma of the bladder does not yield good results by any form of treatment but though radium produces as good results as surgery we have as yet made small headway

Seeds

Seeds can be introduced through the operating cystoscope but their use is so limited by this method that little reference need be made to it.

They are best introduced through a narrow sigmoidoscope such as is used for insertion of radium through colostomy wounds. Seeds should be well screened and contain one to two millicuries of emanation. They act best in early cases it is however very doubtful if they are equal to needles in efficiency

Needles

These are introduced through a narrow sigmoidoscope introduced through a supra pubic cystotomy. Short needles of 20 to 27 millimetres should be used and should be run in obliquely under the base of the growth. If the growth is prominent or fungating the prominent part should be destroyed by diathermy which can quite well be carried out through a cystoscope prior to the insertion of radium

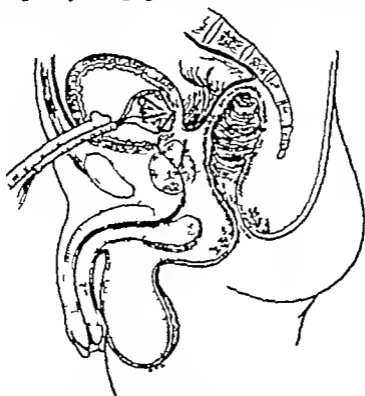


FIG. 53.—CARCINOMA OF THE BLADDER.

Radium needles inserted through a supra-pubic opening

The same instructions with regard to a catheter and the washing out of the bladder are needed as were given in dealing with the prostate

The needles should be threaded with waxed thread which is passed through a catheter and fastened to the abdominal wall. A self retaining catheter is inserted and the supra pubic wound closed. The needles are removed when a dose of about 3000 milligramme hours has been given

The supra pubic catheter can be removed at the same time and an ordinary catheter passed into the bladder. This will hasten the healing of the supra pubic wound.

THE PENIS

Cancer of the penis is of the epitheloid epidermoid type that is sensitive to radium. It is a position peculiarly adapted to its use and for this reason radium has quite superseded surgery.

Cancer of the penis almost invariably starts on the glands and is as invariably associated with phimosis. A circumcision or at all events a slitting of the prepuce is almost essential before the true extent and condition of affairs can be made out.

Some surgeons perform a supra pubic opening and drain the bladder and thus keep the growth dry during treatment. This is unnecessary a catheter tied in will do all that is needed.

Needles

After the circumcision or exposure of the parts the needles should be thrust into the glands all round the lesion. The ends of the needles will in many cases penetrate the corpora cavernosa. The needles should be 20 to 27 millimetres in length and each should contain $\frac{1}{2}$ to $1\frac{1}{2}$ milligrammes of radium.

They should be threaded on thick linen thread soaked in wax and the ends fastened to the body of the penis by strapping which can also be used to fasten in the catheter. The number of needles will depend upon the size of the growth. A dose of one to two thousand milligramme hours should be given. The results are seen very rapidly.

Surface radiation

The use of needles should be supplemented by the use of surface radiation usually to the growth but certainly to the glandular areas.

A loose mould is made to surround the organ and the radium needles are fixed in the soft wax all round the growth on the healthy as well as the affected side of the penis. In this way the growth is attacked from all aspects. The mould is covered with a thin sheet of lead or lead rubber to protect the testes and thighs. This makes it rather heavy and difficult to deal with. It is better also to surround the lead with a thick coat of cotton wool if the patient is up so as to keep the mould as far from the thighs as possible. If the patient is in bed the same thing should be done and the whole can be supported upon a pillow.

The mould is removed for micturition and absolute cleanliness observed. The mould is tied in place by tapes round the waist and these may be supplemented by strapping to the shaved pubis but it is difficult for the patient to wear it at night as unconscious movements may displace it on account of its weight. Constant observation is necessary to make sure that the radium is acting on the right place.

The glandular areas

These may be dealt with at the same time as the needles are inserted into the penis or at the same time that the penis is radiated. A mould is made which fits both sides and if well made can be so arranged that it is not unduly displaced at night and therefore can be worn continually thereby considerably shortening the time of treatment.

The details of arranging the needles time and dosage are all dealt with in speaking of radiation of the glands in the groin in connection with growths of the anus. A block dissection of the glands of the region must also be considered.

CHAPTER XIV

LARYNX

EPITHELIOMA of the larynx when treated by operation necessitates such a severe mutilation of the patient that treatment by any other means which produces anything like similar results is justifiable

Radium treatment of these growths is largely in the hands of the throat specialists and I have only acted in concert with one or more of my colleagues in treating such cases. I shall therefore only refer to them shortly

This type of carcinoma is as a rule a squamous epithelioma and therefore it reacts well to radium. There is a difference in the treatment according to the situation of the carcinoma

The growth may attack the vocal chords ventricular bands or the anterior commissure and can be treated with fair success by operation. In most cases at the cost of destroying the vocal function

The growth may be posterior and attack the arytenoid region and spread by the ary-epiglottidean fold to the epiglottis and interfere greatly with swallowing

It may be situated in the sinus pyriformis and spread to the lateral wall of the larynx or even to the pharynx itself

Preliminaries

These include a careful examination of the part and the determination of the exact extent of the lesion. It will include a careful consideration of the history signs and symptoms the taking of a Wassermann and the removal of a piece for microscopic examination so that the diagnosis is certain. This will all be carried out by the laryngologist

Strict attention should be paid to the toilet of the oral

cavity to eliminate sepsis. A preliminary tracheotomy will be needed in certain cases and will free the upper larynx for the use of the surgeon and swelling of the part has then no longer any terrors.

Seeds

These are especially useful in growths of the arytenoid region but are unsuitable for laryngeal cancer elsewhere. They should be firmly embedded and attached to silk threads the ends of which are fastened to the cheek. The actual insertion of the seeds into the arytenoid region is by no means easy. They should be left in place 7 to 10 days. This treatment is usually followed by the use of needles or Columbia paste collar.

Needles

The insertion of needles requires a special technique usually called the fenestration operation which has been practised by Finzi and Harmer in this country. It is performed under regional anaesthesia or by the intra tracheal method.

Shortly it is the exposure of the wing of the thyroid cartilage of the affected side. The perichondrium and muscles are stripped off and then the cartilage is removed piecemeal the inner perichondrium being left intact. Into the window thus fashioned needles of suitable length are fitted 5 to 10 in number each containing $\frac{1}{2}$ to $1\frac{1}{2}$ milligrammes of radium. The needles may be kept in place by slipping the ends under the cricoid or the cut edge of the thyroid cartilage or they may be fixed in a frame which fits the window. Threads are attached to the needles or frame. The wound is then closed and sealed with collodion.

A low tracheotomy is performed as a last stage to prevent infection of the wound.

The needles are removed after seven days.

(Satisfying results have followed this line of treatment an excellent gramophone record demonstrating the pitch and

range of the voice was shewn by Finzi at the International Congress of Radiology in Stockholm.

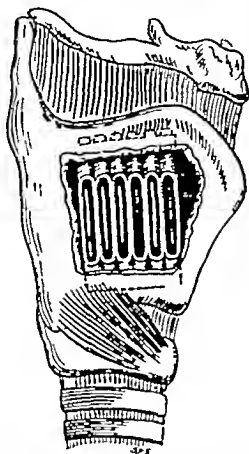


FIG. 54.—LATERAL CARTILAGE OF THE THYROID PARTLY REMOVED. INTERNAL PERIOSTEUM LEFT INTACT. A FRAME CONTAINING SIX NEEDLES SLIPPED INTO PLACE AND LEFT IN SITU FOR SOME DAYS.

Surface radiation.

This is important both by itself and following the use of seeds and needles.

Laryngeal carcinoma not only consists of the primary growth but as a rule it rapidly involves the glands in the neck. Indeed in some cases it is the condition of the glands which first calls attention to the nature of the trouble.

In most cases both sides of the neck should be radiated along what we can term the adenoid areas. As much as 80 to 100 milligrammes of radium may be distributed over

these areas and kept in place for a week to ten days if worn continuously. Probably better results will accrue when we can use these doses intermittently over longer periods such as 12 to 18 hours daily. I must confess that lack of radium has prevented me making a reliable trial of this procedure.

Large doses must be given. The reaction may be severe the growth itself will probably become enlarged and oedematous and increase in the hoarseness and actual loss of voice may be expected. The laryngeal reaction will pass off gradually and the voice will return in a few weeks. For the skin reaction see p. 37.

In the majority of cases relief of symptoms immunity from mutilation and mental repose is all that we can expect. Cure can scarcely be looked for but for that reason will be all the more welcome when met with.

THYROID

A growth of the thyroid is usually a carcinoma but may be a sarcoma. They are so rare that I hesitate to speak of them with authority. In St. Mary's Hospital we have only treated them with needles and tubes but they can be treated by seeds and should be highly suitable for treatment by Columbia paste collars.

Needles

The needles should be 27, 37 or 44 millimetres long depending on the size of the growth so as to pass well into the substance of the tumour. The number also will depend on the size of the tumour. The needles should be inserted on the anterior border of the sterno-mastoid and placed transversely passing as far as possible behind the tumour and between it and the air passages. Longer needles can be inserted vertically either at the top or the bottom of the growth. 27 millimetre needles can be inserted transversely into the isthmus.

On one occasion I also put a tube of radium into the

trachea through a low tracheotomy wound and fixed it in position for twenty four hours with wire

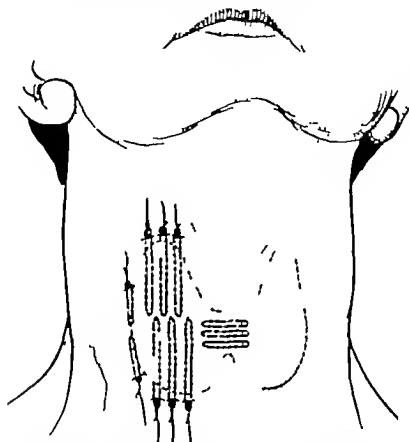


FIG. 55.—NEEDLES INSERTED VERTICALLY INTO THE THYROID GLAND THEY CAN ALSO BE INSERTED TRANSVERSELY

Surface radiation

A collar should be made to fit the front and sides of the neck passing well over the posterior triangles. The outline of the tumour may show through it if not it should be outlined with a pin and the radium distributed evenly over the marked surface. It should be worn continuously for a week or ten days. If thought necessary the trachea and laryngeal cartilages may be protected with lead rubber tissue. The possibility of secondary growths occurring in distant bones must be borne in mind.

Mrs M. R. aged 40 was admitted to St Mary's Hospital under a colleague with a hard mass at the anterior border of the



FIG. 5

NEEDLE INSERTED IN THE LOBES OF THE THYROID GLAND

sterno-mastoid low down about 2 inches by 1 inch not attached to the skin

Wassermann reaction Blood count and X rays negative 2 milligrammes of radium inserted into centre of growth for 100 hours. The growth grew smaller and she was discharged on 2nd August 1928

On 17th December 1928 she was admitted to the Paddington Infirmary with Acute Rheumatism. On X ray examination she was found to have extensive deposits in both femora and humeri and many other bones. There was no sign of thyroid enlargement when shown to the Harveian Society on 9th May 1929

BRANCHIAL CARCINOMA

This is a rare form of residual carcinoma which would apparently be a squamous carcinoma if circumstances allowed it.

It is as sensitive to radium as fully developed squamous carcinoma. It is more difficult to diagnose not being superficial and some time will be lost in establishing the nature of the mass and this will militate against ultimate success as glands are almost sure to be infected by the time the diagnosis is certain

No special treatment need be detailed. It can be attacked either by needles or by surface radiation but owing to its deep-seated position I am in favour of needles though I have used both forms of treatment in the same patient. Adequate doses are essential the following case was probably lost through insufficient radium being available

Mr J. L. aged 51 admitted to St. Mary's Hospital, 25th January 1928 with a hard mass on the right side of his neck which he had first noticed in August 1927

On examination there was a hard mass the size of a walnut underneath the sterno-mastoid muscle half an inch below the jaw. On the opposite side of his neck he had a cartilaginous rudimentary auricle

A modified block dissection was performed and the muscle tumour and some glands were removed.

Pathological Report Numerous large nodules of carcinoma with necrotic centres. Most of the cells are undifferentiated

polygonal cells but in a few areas there is an attempt at squamous formation

Recurrence took place and he was readmitted 24th September 1929 and had a course of lead intravenously and radium applied over the tumour for 730 milligramme hours no more radium was available

Two months later he had surface applications of radium for 890 milligramme hours and 4 needles of 2 milligrammes each placed into the tissues together equalling a dose of 2898 milligramme hours

These doses were too small to have a permanent effect. The mass however went down so much that he did not come to report again till July 1929 when he had some septic teeth removed and glands in his neck could be distinctly felt. In August he complained of choking feelings and was admitted to Paddington Infirmary

I admitted him to St Mary's again in September. By that time he had metastases in the right cheek. I applied surface irradiation and later transferred him to Mount Vernon Cancer Research Hospital where he still is

CHAPTER XV

SKIN

EPITHELIOMA may be of the dry scabby or fungating and ulcerative type. The dry scabby type being the least resistant and the ulcerative type the most resistant to radium all respond fairly well. Like rodent ulcer they may be treated either with needles or by surface radiation.

Needles

In positions where prominent growths are met with it is a good plan to use needles which are thrust in from just external to the overhanging edge and pass into the tissues deep to the growth.

Longer needles can be used in the middle of the growth with shorter ones for the narrow part. Two short needles pushed in from opposite sides will act the same as one long one and are easier to insert.

The needles can be left *in situ* for a week or ten days and then removed. In ulcerated areas the needles may be moved about.

Surface radiation

Surface application can be applied later. In special positions such as the cheek, ear, lip or penis surface radiation is perhaps best as a mould can be fastened so as to allow the radium to act upon more than one surface. In these situations the mould should be covered with lead sheeting or lead rubber to protect the adjacent skin surfaces. This makes it rather heavy so that it has to be tied in place. It is an advantage to make the mould cover a bony point such

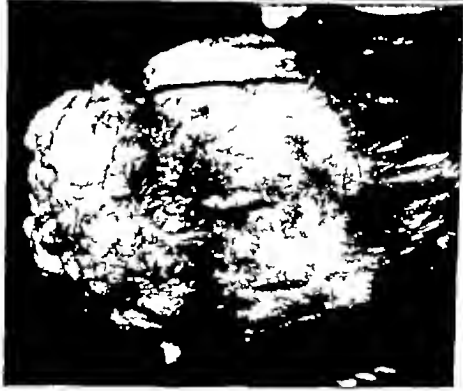


FIG 57 — ANGIO-EPITHELIOMA OF SCALP BEFORE TREATMENT

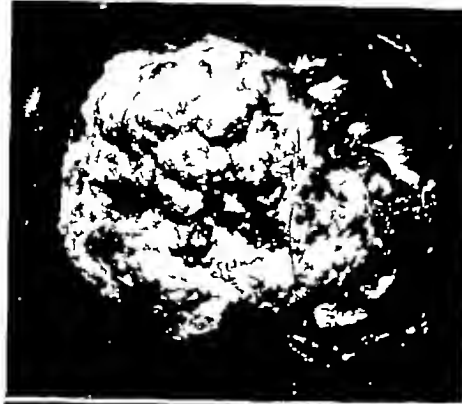


FIG 58 — ANGIO-EPITHELIOMA OF SCALP — ANOTHER VIEW

as the chin jaw or anterior superior iliac spine so as to have a point by which it can be fixed

I have known large epithelioma to completely disappear under treatment



FIG. 59.—NAEVO EPITHELIOMA OF SCALP AFTER TREATMENT
(See p. 149 Mr. A. B.)

Mrs. A. B. 59 years admitted to St. Mary's Hospital 16th November 1928

History She knew she had a small pimple on her scalp at the age of 12 at 25 it was the size of an almond at 50 the size of a walnut after 53 it grew rapidly. There was a history of similar growths on the head of her father and of other members of the family.

On examination there was a prominent wart-like area $2\frac{1}{2} \times 3$ inches on the vertex and back part of the head. It was raised 2 inches above the surface and was ulcerated and discharged a foul smelling fluid. She had a lot of pain in it. See Fig. 57-59

Pathological Report stated that it had been an angioma and was becoming epitheliomatous

She was given large doses of radium spread over some six weeks amounting to 36,266 milligramme hours. She went out and attended as an out patient. The growth diminished very much in size she had no pain and was very pleased with the result.

In March the tumour had almost gone and when seen in May it had completely disappeared but the skin had not yet grown completely over the place

In July she had a fit and was readmitted and later died of a cerebral abscess secondary to an area of necrosis of the skull.

There is however one warning I would give—that is that when large doses say of 30 000 milligramme hours or upwards have been needed over a long period to destroy a growth healing by skin growing in may be delayed for months.

The treatment of the glands has already been dealt with in dealing with the tongue (p 48)

Rodent ulcer

Rodent ulcer though approaching the adenomatous type of carcinoma is still very sensitive to radium in the majority of cases. Large and old standing cases even where the bones of the face have been invaded may be cleared up completely. Plastic operative procedures may be needed later to fill up the gap which remains or the defect may be remedied by wearing a suitable apparatus or shield. Some ulcers do not respond in this way these however are rare

Needles

Needles of $\frac{1}{4}$ to 15 milligrammes of radium screened by 0.5 of platinum are run under the ulcer from the periphery parallel to each other. In small ulcers two or three needles will be sufficient in larger ulcers the needles may have to be inserted from opposite sides of the ulcer so as to cover the broadest part. It is better to place them parallel to each other but they may be arranged in a radiating manner from the edge to the centre. The needles are left in for a week or ten days

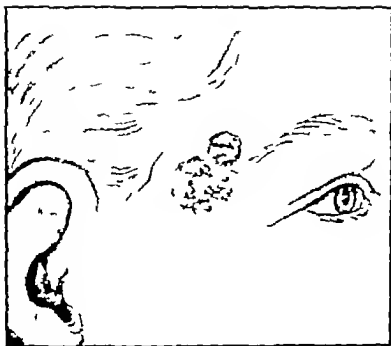


FIG 60

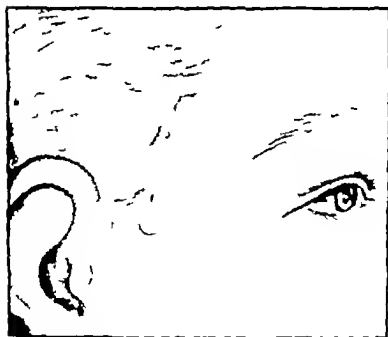


FIG 61

ROBENT ULCER MR T. BAYOUR AND AFTER TREATMENT

Miss T a patient of Dr James of Ealing was sent to me on 28th February 1929 She had had a rodent ulcer near the outer canthus of her eye for ten years Various methods of treatment had been adopted without effect.

Two one milligramme needles were made to underrun the ulcer and were left in for ten days giving a dose of 480 milligramme hours The ulcer completely cleared up by the end of April and she has been free ever since Figs 60 and 61



FIG 62 — NEEDLES PUSHED IN UNDER RODENT ULCER AND TIED TOGETHER, EACH PREVENTING THE OTHER COMING OUT OF THE TISSUE

Surface radiation

In small ulcers a small block of paraffin can be cut to the desired shape and the needles embedded in it and the block strapped upon the part In larger ulcers Columbia paste is moulded to the surface so as to cover the ulcer and a fair margin of tissue round In these cases there is the depth of the ulcer to consider as well as its extent and bone may be involved in the deeper parts Large doses should be employed in such cases The area of the ulcer can be scratched upon the outer side of the mould with a pin and the heated needles sunk into the mould Care must be taken to see that they overlap the edges of the ulcer The patient should be admitted to a nursing institution and the mould worn continually The dose can be made particularly heavy over the centre of the ulcer where no damage can be done to the skin In these cases the mould may well be made considerably larger than necessary and extended so as to take fixation points on the ear nose or chin in this way it may be fixed more firmly in position and will not become displaced during sleep These extensions need not be as thick as the part covering the ulcer

The mould should be removed every 48 hours so as to cleanse the surface as secretion will collect under it. I usually cover the surface of the ulcer with two or three thicknesses of gauze wrung out in some antiseptic cut to the exact size of the sore.

Mr M. aged 75 a patient of Dr Morrison of Duffield had had a sore on his right cheek for ten years or more. It had been



FIG. 63.—ROBENT ULCER OF TEN YEARS STANDING DEEPLY INVADING MALAR BONE. Before treatment

operated upon twice and received X ray treatment but had never healed. He now had a sore below the right eye $1\frac{1}{2} \times 2$ inches with a shelving edge behind and a prominent overhanging edge above and in front. The tissues below the eye were red and swollen.

9th May. A plaque of Columbia paste was fitted which he wore for 13 days with varying amounts of radium arranged upon it. He had 6 320 milligramme hours and then went home. Improvement began almost at once.



FIG 64 —THE SAME FOUR MONTHS LATER.



FIG 65 —THE SAME SIX MONTHS LATER.

12th July The area had almost disappeared a small scab measuring $\frac{1}{2} \times \frac{1}{2}$ being all that was left Figs 63-65

If large doses are used the surrounding tissues should be protected by lead rubber a window being cut to fit the ulcer with a margin left all round so as to act upon any cells which may have infiltrated beyond the visible edge of the lesion

At St Mary's Hospital having a plaque of 10 milligrammes of radium we use that but it is too small for large areas. Larger areas can be dealt with by moving the position of the plaque so many hours being given to each area. The block is used without admitting the patient to the wards the daily attendance being from six to eight hours two or three times a week or daily if the patient can spare the time this spreads the treatment over a long period

The frames shown in Fig 22 are useful as they can be filled with needles of the required strength and number dipped in paraffin and fastened to the block

CHAPTER XVI

PAROTID TUMOURS

WE need not discuss the exact nature of parotid tumours they are known pathologically under many names and contain a variety of tissue. They are usually composed of mixed or endotheliomatous tissues. In my experience they seem to react readily to radium but have all done it in rather a peculiar way. They are solid tumours to start with but under the influence of radium they break down and become fluid. They can then be evacuated through a small opening which allows any debris to be scraped out. They then shrink up entirely whether they ever grow again is too soon to say.

I have always treated them the same way by needles or tubes.

Needles and tubes

In large tumours I have always inserted 27 37 or 44 millimetre needles into and around the tumour and left them *in situ* for a week or more before removing them. It is highly important to use needles with a lengthy silent area towards the eye that is to say the radium well towards the point of the needle otherwise a pock like scar may be left upon the cheek. This is the more important in ladies.

At the end of one to two months the tumour should have been reduced greatly in size and become cystic.

A small incision can then be made in front of the lobule of the ear or some other suitable place for hiding the scar. The skin is retracted and a deeper transverse incision made parallel with the fibres of the facial nerve into the tumour. A thick blood stained fluid can be squeezed out and the interior of the cyst be scraped with a sharp spoon. A tube of

30 to 50 milligrammes of radium is inserted into the cavity. Deep sutures are inserted round the empty cyst and tied so as to occlude its cavity. The skin is accurately sewn up leaving plenty of room for discharge to exude between the stitches. The tube is removed on the second or third day. As a rule the face swells up very considerably but this passes off in a few days.

Shrinkage of the remains of the tumour steadily takes place.

George M. aged 73 admitted in April for a swelling of the right parotid which appeared at the beginning of the year. This had grown slowly and painlessly.

On examination there was a diffuse mobile swelling in the parotid 3×2 inches which projected about an inch above the surface. Radium needles were inserted all round the growth and a dose of 17.8 milligramme hours was given. A month later the tumour was much smaller. He was readmitted in July and the tumour opened when a large amount of thick dark fluid escaped. A portion of the cyst wall was removed for examination.

A 30 milligramme tube of radium was inserted and the cyst occluded. A dose of 1.425 milligramme hours was given.

Pathological Report—Cyst lined by a single layer of cubical epithelium resting on a thick fibrous wall infiltrated with leukocytes.

In September the tumour could just be felt as a deep thickening.

I have another patient a lady who had a small tumour in whom I dispensed with the needles made a small incision scraped out the interior of the cyst and inserted a tube of 30 milligrammes which was left in place two days ($30 \times 48 = 1440$) with excellent result.

I still have a man who had a very large prominent tumour of the parotid into whom I inserted 281 milligrammes of radium in needles of various lengths so that he had a dose of 57.6 milligramme hours. His tumour had decreased so much in size that he has not yet made up his mind to have the other half of the treatment.

The following case is one which was treated rather differently with equally good results.

John I. aged 19 admitted to St. Mary's Hospital 14th January 1909 with a parotid tumour which he had noticed first in June

Immediate removal of the testis is the only method of dealing with them which can be considered safe and if taken early enough before spread has occurred success may be attained. If however the glands along the internal iliac vessels enlarge and they do in these cases though the true lymphatic glands are situated normally higher up along the aorta the patient must be regarded as beyond the scope of operation.

I have known however two such cases both treated by radium needles one of whom was inadequately treated four years ago by a surgeon whose knowledge of radium was limited this patient died. A second treated at a later period when more was known about radium who is now apparently cured.

Dr F H treated by Professor Pannett for tumour of the right testis which was removed 28th November 1917. On 10th December 1927 the abdomen was opened and a mass exposed just above the bifurcation of the aorta behind the peritoneum whitish in colour and soft in consistence. A rubber tube was led from the tumour behind the peritoneum and four 2 milligramme needles were inserted into the growth the threads of the needles being brought out through the tube about 960 milligramme hours were given.

Pathological Report Alveolar and papillary columnar and polygonal celled carcinoma of the testis. The growth is very necrotic in the centre but is growing rapidly at its edges. Mitotic figures are numerous.

The whole of the tumour disappeared and after a convalescence he returned to practice and has remained perfectly well ever since.

CHAPTER XVII

SARCOMA

General considerations

SARCOMA is so rare that few cases come under the observation of one surgeon and a long time must elapse before any individual surgeon sees a sufficient number to become anything like an expert in their treatment

As a sarcoma is more embryonic than a carcinoma it is only justifiable to expect that it would yield more readily to the influence of radium and this in the majority of instances is found to be the case. It varies in sensitiveness the round-celled being more sensitive than the oval-celled

It is hardly necessary to emphasise that the only hope a patient suffering from sarcoma has lies in early diagnosis and early treatment. As we all know the outlook in sarcoma is extremely grave even when operated upon early as metastases may have already been planted in other organs and however radically the primary growth may be removed the metastases if present will slowly grow and appear at a later date in some inaccessible organ

The use of radium in no way alters this problem and therefore we cannot expect the prognosis to be better with radium than with operative cases unless we can get the patients treated at an earlier date

Now there must be a strong desire on the part of parents to avoid an extensive operation upon a child or young person especially an operation of the nature of an amputation and much time will probably be lost and further consultations and advice will be needed before they can be persuaded to give their consent to such a proceeding

With radium on the other hand as its use will possibly

obviate the necessity for operation early treatment will be welcomed by parents. In this way time will be gained. In its time-saving influence radium will have a very great advantage over operation.

I am considering all forms of sarcoma together as no difference need be made in their treatment except perhaps in the case of the sarcoma of the bones. A sarcoma of the soft tissues would naturally respond better to radium than would sarcoma of bone because physical reasons would make it easier to put radium in contact with certain parts of the tumour.

Needles

The tumours are best treated by the insertion of needles or surface applications or the one following the other. For size of the tumour a comparatively small dose may suffice to destroy it the amount of radium however should not be spared we should make certain that a lethal dose is given excess can be excused if the result is good. The needles should be arranged round the edge of the tumour as in a carcinoma. They can be removed after eight to ten days. As a rule the primary growth can easily be dealt with the anxiety lies with the uncertainty for the future and the possibility of internal metastases growing from cells which have already been disseminated.

Formerly before the use of needles was established I used tubes in the treatment of sarcoma.

V. A. aged 11 years seen in January 19 . . . Seven weeks previously she developed a small nodule in her left parotid gland which was rounded soft and almost fluctuating and thought to be a tuberculous gland but the possibility of malignancy was kept in mind. An operation was performed but the tumour could not be completely removed. The pathological report stated it to be a large round-celled sarcoma. A tube of 20 millicuries of radon was inserted and everything was satisfactory for seven months when the tumour returned round the old scar. Two tubes of radon were inserted and again the tumour disappeared. Four months later it again returned and spread widely over the face. She died

some three months later. In this case I think failure was due to an insufficient amount of radium being used and the insufficient number of the foci.

Ellen D. aged 71 admitted to St. Mary's Hospital with a sarcoma of the right buttock which had been noticed for nine months but which had grown with great rapidity for the last three months.

On examination there was a tumour about the size of a rugby football situated in the region of the right buttock extending over the trochanter. The edges could not be defined. She was a stout woman still but had lost weight lately.

The case was quite inoperable and I did not think we had enough radium to treat it adequately. Fifteen needles were inserted on the 12th together with a tube of 100 milligrammes which was moved daily. These were removed on the 19th about midday the same evening 21 needles and two tubes of 45 and 50 milligrammes were reinserted for three days when she died suddenly. She was very fat and had a broncho-pneumonia. In all she had 23.294 milligramme hours.

Post mortem refused by relatives. Portion of growth removed for microscopy.

Report on Microscopic Section. Fibrosarcoma growing from intermuscular septum near great trochanter. Fibrin and necrotic tissue are well shown near the radium tracks but the tumour is so necrotic that it is difficult to see how much change the radium has caused. In parts the tumour is actively growing.

Besides developing a slight broncho-pneumonia which did not seem sufficient to account for her sudden death her heart may have been affected by the rapid breaking down and absorption of the tumour and protein shock such as was described by Loeper and Tonnet may have had something to do with this.

Latterly small sarcomata have been treated by needles and large ones both by needles and tubes.

There is a possibility that a tumour may break down so rapidly under large doses of radium and absorption of the waste products may possibly produce unforeseen results (see p. 40).

Surface radiation

Surface application by means of Columbia paste is more likely to be successful in superficial growths than in those which extend deeply. In the latter a course of needling followed by Columbia paste mould is probably the better method.

Surface irradiation should be carried out after the reaction of needling has passed off. It will act as a sort of second barrel to our gun and make sure of destroying the embryonic cells.

This should be carried out exactly in the same way as for carcinoma. A mould is made sufficiently large to cover the affected area and the radium applied to the outer side and left in position for a sufficient time.

Surface irradiation should be spread over a considerable area around the tumour. It is just as well I think to make the dose of radium relatively large and the reaction consequently rather severe, the mould being worn for 10 to 14 days. The severity of the reaction can be diminished by only wearing the mould for so many hours a day, but this requires a large supply of radium over a long period while other patients may be needing it. A limited supply of radium must modify our procedures.

Columbia paste plaques can be applied over the abdomen and thorax to deal with internal masses, but this is merely staving off the inevitable end.

A boy eighteen months old was admitted to Paddington Green Children's Hospital in September 1928 with a tumour of the nose the size of a hazel nut growing into and occluding the left nostril. It had been noted at birth and had grown steadily.

It was removed, but it was more than doubtful if it had been removed completely.

Pathological Report was sarcoma and naevoid tissue.

He was transferred to me at St. Mary's Hospital and a Columbia paste mask was made and 95 milligrammes of radium applied to the outside. We had a good deal of trouble with the child as he had to be put in a modified straight waistcoat while he wore the mask, which had to be fastened so that he could not roll over.

and rub it off his face. He wore it for periods varying from 2½ to 5½ hours and obtained a total dose of 1797 milligramme hours.

Since this the growth of the nose has not increased any further in size and with the continual growth of the child trace of deformity should disappear. He comes up regularly for inspection.



FIG 68

CHILD WITH COLUMBIA PASTE SHIELD APPLIED TO NOSE.

Sarcoma of the long bones

Sarcoma of the long bones usually occurs in patients of about the school age and as a rule there is a considerable delay in establishing a diagnosis. In many cases some partial and incomplete operation has already taken place and a portion has been removed for examination by the microscope before diagnosis is certain. These partial operations diminish the chances of ultimate recovery more than anything else as they open up vessels and fascial planes along which dissemination may occur. The outlook is grave enough at all times but such procedures render it far worse.

Needles

These should be inserted all round the tumour in a radiating manner so as to kill the growing edge. The length and

number of the needles will vary with the size and extent of the tumour. They should be left *in situ* for ten days. When the reaction has subsided needles can again be inserted into the substance of the tumour itself. These needles should be long enough to pass into the base of the tumour close to the bone. I have never left such needles in place longer than five days for fear of necrosis of the bone. Some surgeons rather object to this method of treatment as possibly opening up paths of dissemination but I think the risk must be very small. In most cases where the tumour is superficial surface radiation should follow.

Miss O. K., aged 17½ was sent me by Dr. Craig. Her history was that in September 1928 she complained of pricking sensations in her right arm. In December she returned from school and a lump was noted the size of a pigeon's egg above the elbow on the inner side.

This was thought to be unimportant but was removed in April and found to be a round-celled sarcoma which recurred at once. She was treated with Coley's fluid but the tumour grew steadily.

Examination. There was a tumour in the triceps muscle stretching across the back of the arm measuring 4 × 4 inches.

4th July. Two 60-millimetre 3 milligramme needles, seven 44 millimetre 2 milligramme and eleven 27 millimetre 2 milligramme needles were placed round the tumour and a 30-milligramme tube inserted into its centre. This was moved daily. In all she had 10,224 milligramme hours.

21st August. The skin still showed superficial blistering and redness but no tumour could now be felt.

17th Oct. Not a sign of the tumour is to be felt.

Surface radiation

I have only carried this out in a few cases partly from lack of sufficient radium and partly because of the thickness of tissue which has intervened between the skin and the tumour. In a muscular thigh two or more inches of muscle can quite well separate a sarcoma of the femur from the skin and if the radium is placed 15 centimetres from the skin the distance between the radium and the depths of the tumour becomes so great as to create doubts as to the utility of the

proceeding Time and experience are needed to clear up these questions

In sarcoma of the humerus I have surrounded the portion of the arm affected with a Columbia paste mould and applied the radium in sufficient doses to cause a severe reaction of the skin The results so far have been excellent

HODGKIN'S DISEASE

Radium produces a more striking and immediate effect on masses of glands in Hodgkin's disease than it does in any other disease I know A child whose supraclavicular fossae are completely filled with masses of glands so that the line of his neck passes from his ears to his shoulders if treated with radium may become a normal looking child in two to three weeks

Needles

I have always used needles in the treatment of such cases for the sake of economy of radium and because they act so well Needles of 44 millimetres are thrust into and around the most prominent parts of the mass of glands They may be placed two to three centimetres apart and may be left in for a week The dose need only be a small one compared with the masses affected so that a large number of needles is not necessary

Surface radiation

This is easily carried out in the usual manner but at the end of ten days to a fortnight the Columbia paste mould would no longer fit the neck the reaction is so rapid

Result.

The result of this treatment though satisfactory for a time is purely transient the masses always recur Nor does this treatment delay the formation of masses in the liver spleen or other lymphatic areas Here again X rays have a marked

influence but also only for a time. A cure by any means has never been produced. I have combined the use of radium with the administration of arsenic given intravenously (neo salvarsan) and also with a course of lead injections. I have never seen permanent benefit ensue.

So little is really known about this disease that progress can hardly be looked for. If the secondary masses found in the liver and spleen were proved to be true metastases then hope might be entertained that large doses of radium applied early might possibly do good. So far I have only used small or moderate doses.

C. C. aged 6½ years was seen by me at St. Mary's Hospital and diagnosed as lymphadenoma from the mass of glands on the right side of his neck. In October 1920 he was given arsenic intravenously in the form of neo salvarsan. He was then ordered deep X rays which he had on six occasions. He improved greatly for a time and his glands got smaller but during March and April 1921 they began to enlarge. He was admitted into Paddington Green Children's Hospital, and some glands were removed for examination and 50 milligramme of radium was inserted for 2½ hours. The pathologist reported lymphadenoma with much fibrous endothelial cell proliferation.

After the radium he was so much better that he was shown at some of the medical societies.

On 29th June 1922 he was readmitted with a neck which measured 13 inches in circumference and with his spleen becoming enlarged. Seventy-one milligrammes of radium in needles and tubes were inserted, and in three weeks his neck became of normal size. His spleen continued to enlarge. In December of the same year his neck began to enlarge again and his spleen was down to his umbilicus.

I have not the date but he died about a year later.

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